JUNE 1988 $4.75 NZ$6.00 inc. gst

Incorporating Elektor Electronics

ROGER HARRISON'S

AUSTRALIAN ELECTRONICS Monthly

FOUR-SPEED MODEM PROJECT

FOUR-INPUT AUDIO MIXER TO BUILD

SETTING UP PA SPEAKERS

BATTERY CHARGING

NEW COLUMN! RESTORING VALVE EQUIPMENT

KENWOOD RZ-1 SCANNER REVIEWED

VIDEO CAMCORDERS — WHICH TO CHOOSE?

audio ● video ● computing ● communications ● projects ● engineering ● technology

BALMAIN 2041 NSW

COPYRIGHT 1988, KEDHORN HOLDINGS P/L

CHECK THE FEA
6" 2kV CRT 17ns
BS
*150 only
21 Years 1967–1988
NEW SOUTH WALES
18 Hilly Street, MORTLAKE
P.O.Box 30, CONCORD
NSW 2137
Tel : (02) 736 2888
Fax : (02) 736 3005

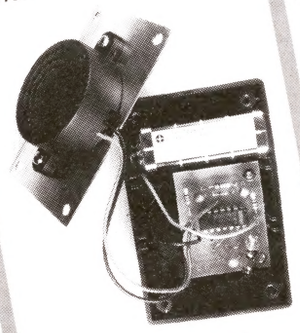
ADVERTISERS INDEX

AES Electronics 25
Arista 28-29
Captain Communications 95
CLC 65
Datacom 16
Dick Smith Electronics . 18,20-21, 60,79
Eagle Electronics 75
Emtronics 97
Etone 27
Energy Control 67
Geoff Wood Electronics 55
Jaycar 52-53
JVC 17
Kenwood Electronics 92
Maestro 80
Panasonic 11
Power-Sonic 27
Ritronics 81
Siemens 0BC
Sony . . . . . IFC
Stewart Electronic Components 54
Thomas Electronics 79
WIA . . . . . IBC

PROJECTS TO BUILD

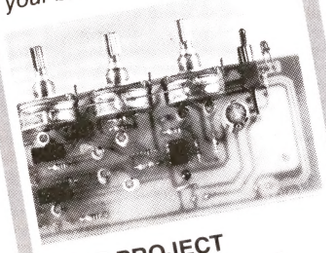
AEM4624 SUPERbis Modem 84

Here's the lowest cost 4-speed modem on the market – and you can build it yourself. This month we detail how to construct and perform the first tests.



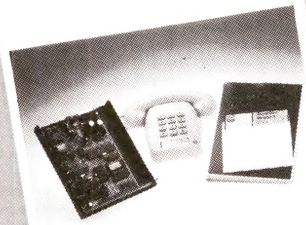
AEM1503 Tilt Alarm 56

Tilt it 20 degrees and it goes bee- beep-bee-beep! Save your kitchen chairs from the "swingers", protect your golf bag, save your bike! Dozens of uses.



STAR PROJECT
Four-Input Mini Mixer 61

Here's a versatile audio mixer that can be used for a host of applications – mic mixing, guitar and mic, tape and mic, dubbing audio on a video tape, etc. Low cost and simple to build.



COVER
It's the SUPERbis modem! This month we get down to the nitty gritty of construction and testing. Photo – David Liddle. Design – Val Harrison.

CIRCUITS & TECHNICAL

NEW REGULAR FEATURE!
Vintage Restorations 76

This issue we commence a regular column for readers interested in collecting and restoring old radios, sound equipment etc. Aahh! The warmth of glowing filaments and the smell of overcooked trannies!

Speaker Placement in PA Systems 23

PA and sound reinforcement systems, no matter whether they're indoors or outdoors, can stand or fall on how the speakers are placed. Here are some practical hints.

Filter Design – without fears or tears – Part 9. 68

The best wine has been left till last. This month Jack Middlehurst concludes with switched capacitor filters – they're so simple you'll wonder why he didn't describe them first!

Semiconductor Scene 66

Keep in touch with what's happening in the world of semiconductors.

DATA SHEET 88

The Zilog Super8 micro – as used in our SUPERbis modem project.

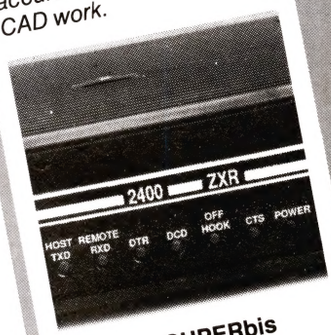
ELEKTOR IN AEM

Contents 33

PRACTICAL COMPUTING

REVIEW
The "Dicky Mouse"! 83

All mice are the same, right? Not this one! It uses a unique optical sensing technique giving very accurate results. Great for CAD work.



Build our SUPERbis Four-Speed Modem 84

A 4- speed modem kit for under $350? It's true! Another fantastic design from Maestro.

SPECIAL OFFER
AEM4624 SUPERBIS MODEM KIT 91

Build yourself this great 4-speed modem and save heaps!

SPECIAL OFFER
A Real Time Clock Add-in for IBM PCs and Compats – $49.95! 8

Last chance to get a versatile, low-cost RTC that takes minutes to inst
As described in our Fet
issue.

COMMUNICATIONS SCENE

EQUIPMENT REVIEW 94

We put Kenwood's RZ-1 scanning receiver through its paces.

CONSUMER ELECTRONICS

Video Camcorders; VHS vs 8 mm – it's Consumer's Choice! 12

With the battle lines well and truly drawn between the VHS and 8 mm "camps", the outcome in the camcorder market will be decided by the consumer. Malcolm Goldfinch reports.

NEWS & GENERAL

Some Light on the Charge Brigade 30

A little "refresher" on lead/acid and NiCad battery charging characteristics and charging techniques.

News Review 6

Satellite aids polar skiers.

Letters 8

Bouquets, brickbats & all!

Consumer Electronics 10

New era video tapes.

Professional Products 19

Numeric display for CRO.

Retail Roundup 54

New parts drawers.

Project Buyers Guide 54

Kits and bits suppliers.

Bytewide 80

New AT chipset cuts cost.

Spectrum 93

CRT display on new rig.

Benchbook 96

Circuit hints from readers.

Subscriptions . . . . . IBC

The Last Laugh 98

NEXT MONTH!

VERSATILE POWER SUPPLY PROJECT

This is the first of two power supply projects based upon a remarkable circuit which offers a number of highly desirable features. Next issue we describe version one which is a high quality, very versatile unit suitable for beginners of all ages. It is simple, fully protected, provides variable voltage and current limit, is low in cost and has such low power consumption and such wide tolerances that it may be run from bell transformers, model railway transformers or even batteries, which makes it totally safe.

BEWARE THE STATIC DEMON!

Static electricity can be the nemesis of electronic components and equipment, wreaking havoc where you least expect it. Here's a rundown on how it arises, just what it can do and how to deal with it if you deal with electronic components or equipment.

PRACTICAL GUIDE TO MAKING SUCCESSFUL VIDEO FILMS

Got a video camera or camcorder? Dave Jeanes shows how to go about making a video that doesn't look like "home movies". He explains the technology and the techniques that will help you make a success of your next attempt.

CHARGE-COUPLED DEVICES

Widely used in video cameras these days, Alan Denby explains how these fascinating electronic image sensing devices work.

While these articles are currently being prepared for publication, unforeseen circumstances may affect the final contents of the issue.

FEATURE

Video Camcorders; VHS vs 8 mm: – Your Choice! 12

Looking at buying a video camcorder – read this article first! Malcolm Goldfinch explains the market.

Polar skiers tracked by amateur satellite

A joint Canadian/Soviet team of skiers reached the North Pole on 26th April, 54 days and 1000 km after setting out on their "Transpolar Ski-Trek." During the trek, the team received daily progress updates of their location from the UoSAT-2 DIGITALKER experiment which transmits in the 144 MHz amateur band.

The DIGITALKER is a digital voice synthesiser aboard the spacecraft which can provide speech output of data uploaded to the satellite from a ground control station. The two UoSAT satellites currently in orbit were designed and constructed by a team from the University of Surrey in England. Their main function is educational, providing schoolchildren and anyone else interested with "hands on" experience of space systems technology.

The team's arrival at the North Pole marks the half-way point in their 2000 km trek from Cape Arktichesky on the Severnaya Zemlya archipelago, USSR, to the Cape of Columbia on Ellesmere Island, Canada.

The team was joined at the Pole by journalists from around the world – flown in for a unique North Pole press conference.

In recognition of the assistance that UoSAT-2 continues to provide for the skiers, Michael Meerman (G0/PA3BHF), member of the University of Surrey's UoSAT Spacecraft Engineering Research Unit, was invited by the Soviet Ski-trek leader to attend the press conference at the North Pole. Michael has been responsible for loading the Ski-trek reports to UoSAT- 2.

Thousands of schoolchildren throughout the world have been tracking the skiers by listening to the UoSAT-2 DIGITALKER, and learned about polar exploration through weekly Ski-trek updates authored by AMSAT-NA member Rich Ensign (N8IW]).

Insecure radio? Nevermore!

The final element of RAVEN, the Australian Army's new combat net radio system, has been delivered by the prime contractor, Plessey Pacific Defence Systems.

This was the Frequency Management Facility (FMF), which is a unique system of assigning and distributing radio frequencies and call signs to portable battlefield units.

RAVEN is a $350 million Australian Department of Defence project comprising a new generation of frequency hopping radios highly resistant to jamming and eavesdropping.

Electronic Countermeasures (ECM) have become very sophisticated in recent years, and are a significant threat to military operations.

RAVEN uses a number of techniques to counter ECM, including frequency hopping – the automatic, synchronised switching of transmit and receive frequencies according to a predetermined code – making transmissions difficult to intercept.

The heart of the FMF is the Frequency Management Processor, a computing centre which generates the frequency assignments for an entire Army Division or Corps. The processor is a militarised minicomputer housed in a rugged shelter which can be truck mounted or airlifted.

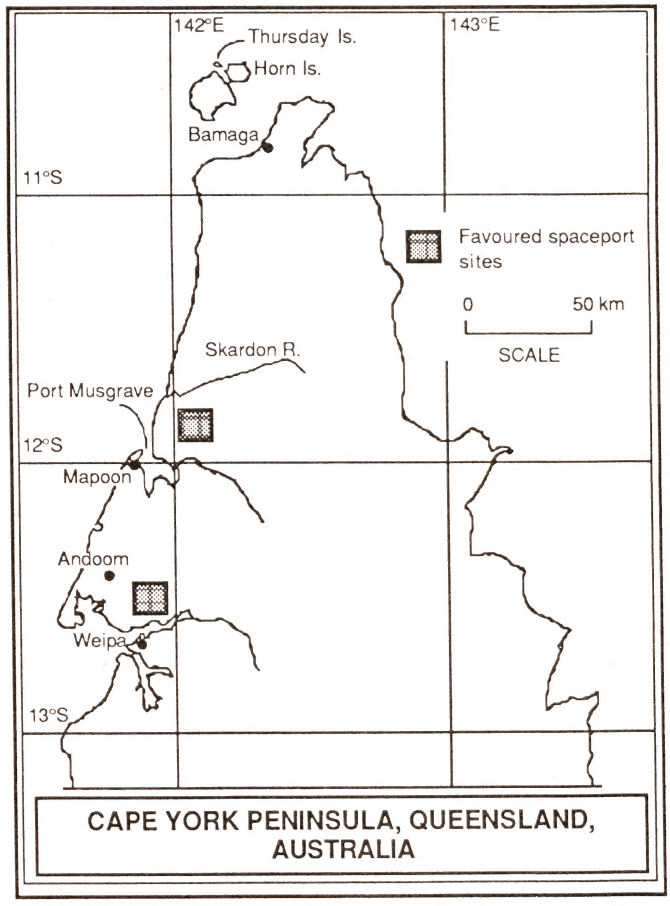
The frequency management software used by the FMF was developed entirely in Australia. It takes into account nearly all factors relevant to communications in a battlefield environment.

Frequency allocations are distributed down through all levels of the RAVEN system without ever having to be seen on paper or entered manually.

The FMF is an all-Australian innovation, the product of a cooperative development programme between the Department of Defence and Plessey Pacific Defence Systems, based in Sydney. The 35-month FMF prototype development, with all its potential for technical snags, has been delivered on target.

Because the FMF is the only system of its kind in the world, the export potential is enormous. Plessey is actively marketing it as part of System 4000, the export version of RAVEN. System 4000 is already undergoing evaluation in Turkey and strong interest has been shown from Malaysia, Brazil and the USA.

Will the Australian soldier have to cope with jamming and interception of his radio signals in future? Quoth the RAVEN, nevermore!



Cape York spaceport closer

Progress on the proposed Cape York spaceport continues, following a recent forum in Brisbane on the project's commercial opportunities.

Almost two years ago the Queensland Premier was first approached about the establishment of a commercial spaceport on the Cape York Peninsula.

The Phase 1 pre-feasibility study concluded that the Cape York site appears to offer a number of significant advantages over most existing operational sites in the world, and that present forecasts show a potential segment of the commercial market that a Cape York spaceport could capture.

It has been estimated that 25% of future world satellite launch business will be handled by a spaceport in the South Pacific region, be it the proposed Cape York facility or not.

A Cape York commercial spaceport is considered to be Australia's one and only opportunity to get into the multi-billion dollar business.

Development cost is estimated at $1.5 billion to reach the operational stage, plus a further $6 billion to fully develop the facility.

The current cost of launches is between $US1.5 – 5 million each, and it is estimated that Cape York could attract an average of between 19 and 32 such launches per year. This cost,

however, is currently heavily subsidised by governments, and a commercial facility such as at Cape York would have to charge substantially more per launch.

Tourism could contribute considerably to the area's revenues as well. The Florida and Houston space facilities attract five million visitors per year, 20% of them from overseas.

The spaceport is intended to be a commercially viable venture, and government is not expected to provide financial assistance in the form of risk capital.

The proposed 10 km landing strip could have military applications, however, and this could involve the Federal government in spending for defence-related use of the facility.

New AUSSAT remote communications venture

British Aerospace Australia (BAeA) and AWA recently signed an agreement under which they will spend more than half a million dollars on a feasibility study leading to the design and manufacture of an all-Australian satellite-based communications system.

Named L-Band Mobile, the system will be linked to the new generation AUSSAT B series of satellites due to be launched in the early 1990s.

The system will be designed to provide high-speed reliable voice and data links between vehicles and/or offices throughout Australia, including remote areas.

L-Band Mobile is expected to prove invaluable to organisations and individuals working in remote areas of Australia, such as mining organisations, trucking and coach concerns, long distance trains and shipping operations in the 200 mile maritime zone.

A potential domestic market of more than 50 000 units, and an even greater export market is envisaged for the system. The feasibility study is expected to be completed by the end of the year.

Aussie car phones for Canada

Philips radio communication manufacturing centre at Clayton, Victoria has won an initial Canadian order for 1200 cellular car phones Shipping commenced in April.

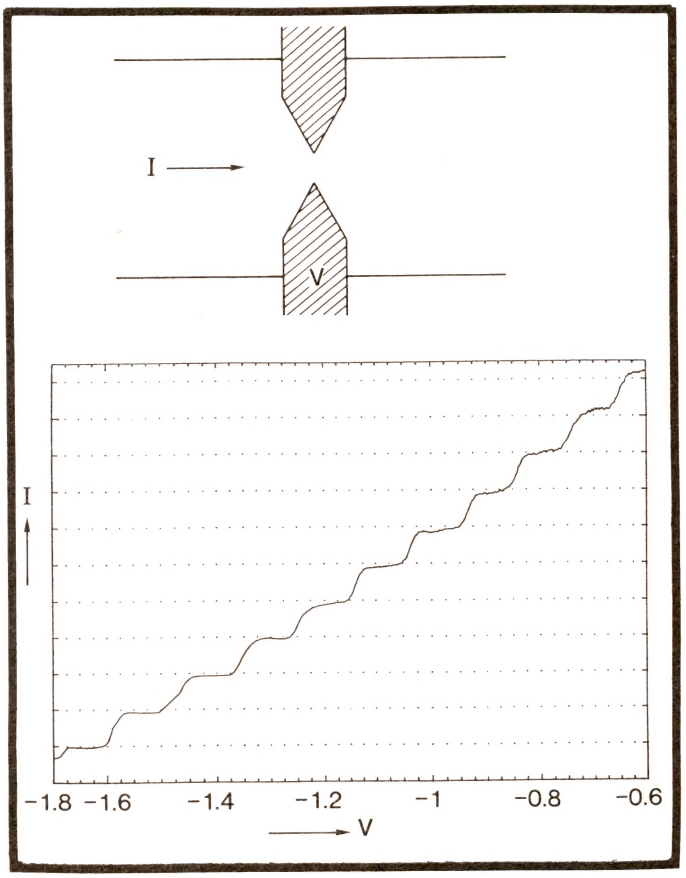
The cellular transportable phone system adopted by Telecom was developed in North America, so the Australian designed and manufactured products are entering a mature, competitive and discriminating market.

Philips Australian car phones have also gained type approval from the Federal Communications Commission (FCC) in the USA, and pilot orders have been delivered there for assessment at the Land Mobile Radio Exhibition in Las Vegas. This will determine the car phones' potential in the enormous USA market.

New conduction effect revealed

Philips Research, in close cooperation with Delft University and the Foundation for Fundamental Research into Matter, have described a newly-discovered effect concerning the conductivity of electrons through a narrow contact.

The research has established that the conductivity of a narrow connection between two areas of semiconductors at just above absolute zero does not change uniformly as the width of the contact decreases, as might be expected, but in extremely regular steps.



The size of the steps depends only on fundamental physical constants (the electric charge and Planck's constant), and not on material properties or the shape of the connection.

These results have been confirmed independently by researchers at the Cavendish Laboratory of the University of Cambridge.

The measurements were made on aluminium gallium arsenide, upon which two insulated metal electrodes, spaced at 0.25 μm, were applied.

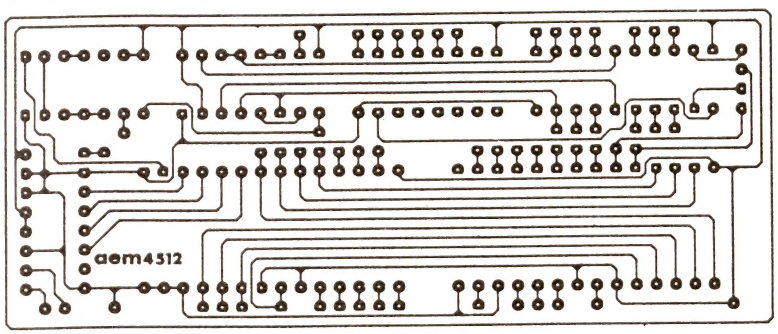
In measurements of the conductivity of the contact it was found that with a gradual reduction in the width of the connection the conductivity decreased in particularly regular steps.

The wave nature of electrons was shown to be essential for the explanation of the effect.

The work also showed that electrodes with such small spacings could be fabricated successfully, and the width of the connection could be varied.

The techniques of Molecular Beam Expitaxy and Electron Beam Lithography, more often associated with the production of solid-state diode lasers and integrated circuits, made this research possible.

OOPS! The pc board artwork for the AEM4512 VZ Ultra-Graphics Adaptor was reproduced upside-down with the board number right-reading. Strange? Here it is, the correct way.



letters

RADFAX and the Challenger

Dear Sir,

Thank you for RADFAX *(Feb. '87)* I am very pleased with the program.

I managed to get the program to do its "thing" after a bit of a wrestle with the timing, and am pleased to say can now get virtually error free RTTY copy from AXM as well as good clean FAX pictures of weather maps with perfectly vertical map edges.

My computer is a Challenger (IBM Clone) 4.77 MHz clock. The figures I used on my computer for delay and fine tuning turned out to be:

DELAY 0098
FINE TUNE 520
SPEED 3 120LPM
PORT 0200

It might help some Challenger user "home-in" on the correct figures a little more swiftly.

I haven't got the Morse to work yet, but I suspect there might be something wrong with my Listening Post now revived to suit IBM input. I have been wondering whether the Morse output from the Listening Post should be inverted. Maybe you can tell me?

While fiddling about trying to get the right timing figures, my thoughts turned to a *FAX Grey Scale Generator* and what a useful tool it would be to set the computer FAX up, especially when one gets into weather satellite FAX.

There is a project featured in the December 1986 issue of *QST* magazine, designed by Mr George Isleib. Maybe AEM could consider featuring a similar type of project in the near future. I feel sure that it would invite the interest of present and future FAX hobbyists.

Fred Lehner,
Launceston, Tas.

EPROM software for CW/RTTY decoder

Dear Roger,

I am very impressed with the concept of your latest CW/RTTY demodulator circuit *(Jan. '88)*, and have gathered most of the parts for this project. But, alas, the crunch has come when I find I have no software to set up the EPROM for the task.

Would you be able to supply this set of software instructions?

I have also had trouble getting hold of a circuit board for this project – in fact the PCB is unavailable in Melbourne. Do you know of any possible suppliers?

I do hope you can guide me fruitfully in my search, and please let me compliment you and your staff on a truly interest-packed and newsworthy publication.

I look forward with anticipation to your reply, and hope my requests will not prove too demanding.

Geoff Tresise, VK3CNX
Hawthorn Vic.

This was a Star Project, from Dick Smith Electronics, cat. no. K-6339. Under a new policy introduced last July (see Retail Roundup, AEM July 1987), pc boards and other major parts for Dick Smith Electronics kits may be purchased separately as "spares". All you need do is go to your nearest DSE store and place an order!

I spoke with Rex Callaghan of DSE's head office, and he informed me that the board and EPROM for the Stand Alone Morse/RTTY Decoder were currently available and obtainable under the arrangements I just outlined.

Roger Harrison

Filter Design programs and C64 BASIC

Dear Sir,

It seems a pity that such a fine magazine should fall foul by sending copies to the news-stand with some 24 or more pages missing. The issue in question is Vol.3 No.10, the April issue.

I hope that you treat this better than another magazine which didn't acknowledge the problem when I wrote, or print the missing pages in following issues.

The articles on filters are very good, but I am having a lot of trouble converting from GWBASIC to Commodore BASIC, as I don't understand GWBASIC. Could you possibly publish the conversion, as I believe that there are a lot of AEM readers with Commodore C64s.

Thank you for a fine magazine.

M. Ralph VK7ZMR,
Tullah, Tas.

Missing pages? Aghast! This sometimes happens to a few magazines and it arises in the binding machinery where our magazine is printed.

It seems likely you missed 32 pages from that issue. The magazine is printed in "sections", and that particular issue comprised three 32-page sections for the "body" of the magazine. These sections are collated and trimmed, their "spines" glued together and the cover glued to the spine on the binding machine. It seems one section from the faulty issue was "missed" on the bindery.

Fortunately, quality control picks up problems such as this before too many issues with missing sections get through. It seems the issue you picked up was one that was missed.

We are always grateful to receive news of any faults with issues – if we don't know, we can't correct them! A "good" issue has been sent to you and we hope you enjoy the contents you previously missed.

Regarding your problems in translating GWBASIC to Commmodore 64 BASIC, we'll look into that and see if we can't find a correspondent who might be able to help.

Roger Harrison

Amiga Listening Post software

Dear Roger,

I have an Amiga 500 and would like to purchase some software and an interface diagram for the Listening Post. I did have a Commodore 64 working well with it, but sold the C64 to upgrade to the Amiga.

I think the Listening Post is the best thing any magazine has thought of yet, in design simplicity and cost – the best by far computer interface for user experimentation.

I give your magazine 100 points over the others in meeting today's needs for us, the readers and users. In asking for this Amiga interface, I would also like to take the time to thank you personally for the magazine. Keep up the good work.

Kerry Lovejoy,
Condobolin, NSW

Any Amiga hackers around who'd like to tackle the job? Call Roger Harrison on (02)555 1677.

PCB for SSB adapter

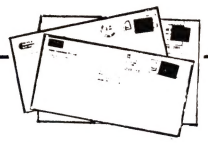
Dear Roger,

I am writing with regards to an article published in the November 1988 issue of AEM, the SSB adapter on page 40.

Firstly, do you make the pc board, and would I be able to purchase one?

Reading the text I understand the loop of wire is wound around the receiver to tune the adapter to 455 kHz. However, I can't understand how the carrier and second sideband is connected to the receiver to produce intelligible audio from SSB.

Please find enclosed a stamped



envelope for your return answer. Any additional information on this topic would be very much appreciated, as I intend constructing it.

John Garland,
Tingira Heights, NSW

Yes, we do have pc boards for the SSB Adaptor in stock. They are supplied to us from All Electronic Components in Melbourne. We do keep small stocks of both our own and Elektor-in-AEM pc boards as a service to readers. We're only a phone call away if you need a board (02-555- 1677). If we don't currently have a particular board in stock whenever you ring, we can suggest other suppliers in your city or state, or interstate.

The aforementioned All Electronic Components has embarked on a program to stock current AEM and Elektor-in-AEM pc boards, and a selection of those we've published in the past.

The SSB Adaptor is a 455 kHz oscillator. It is this that supplies the missing carrier enabling you to "resolve" the SSB signal picked up by your receiver.

Roger Harrison

VIC 20 Listening Post software

Dear Sir,

I am writing to ask about software for the AEM 3500 Listening Post. I have a VIC 20, and was wondering if there has been any software written to suit this machine.

If so, could you please send me details on how to obtain it. Many thanks.

S.Goldthorp,
Wongan Hills, WA.

Unfortunately, we have not produced any software for the VIC 20 to enable using it with the AEM3500 Listening Post. Because the software has to be developed to suit each individual computer, we only have software available for the more popular personal computers. The VIC 20 no longer has such a wide user base that would warrant us arranging Listening Post software for it. In addition, it was discontinued some years ago and the number of people still using VIC 20s will continue to decline. Sorry, but it's a fact of life.

It's a pity there's no "universal" operating system with sufficient speed and basic features to serve all needs. Each new computer "class" or type introduces new features, facilities and advantages – that's evolution for you!

Roger Harrison

6010 preamp problem

Dear Sir,

I have built the AEM 6010 stereo preamp and the 6000 series stereo amplifier, and both worked on first switch-on. I run them with an Ortofon moving coil cartridge and KEF transmission line speakers which I built some time ago (with the ETI crossover). Basically it all sounds fantastic – and some of the best vinyl records sound better than many of my CDs!

However, there is one small problem, with a bit of a 100 Hz "buzz" in the right channel. This is noticeable only with the preamp connected and switched to either the AUX/TUNER or MM setting. Admittedly it is not normally intrusive and to eliminate it would really just be striving to achieve the "perfection" of the rest of the system. It is audible only with one's ear next to the speakers, and is no real problem in itself. But perhaps you can help.

Some more clues – I hope. There is no noise from the power amp by itself. The quietest I have ever heard! Perhaps the problem is in the MC power supply. I have religiously followed the published earthing (0 V) pattern.

I noticed on the circuit board pattern and your published photos of the preamp board that there appeared to be a few more filter capacitors than originally specified. Is this the case, and could their inclusion possibly solve my problem? If so, can you advise me of their layout etc.? I am reluctant to start dismantling the preamp board without some positive direction.

Brian Weavers
Bulleen Vic.

It's curious you should only get the buzz when switched to those two inputs and not the others. I doubt the problem arises in the power supply bypassing, else the buzz would show up when any input is selected, particularly the MC input as this section has the highest stage gain. Check that the RCA input sockets are not touching the chassis where they pass through the rear panel. Failing that, do you have any leads connected to these inputs that are unterminated, or are they connected to other equipment (I assume you're using an MC Ortofon cartridge?) Can you still hear the buzz with no inputs connected?

The "extra" tracks and additional capacitors were for an on-board power supply system that was discarded in the prototype in favour of the scheme finally adopted.

Roger Harrison

PSPICE REVIEW, MAY ISSUE

Prior to preparing this review for publication, we sent a copy of Jonathan Scott's manuscript to Les Dickinson of MicroSim's Australian distributor, MTI Engineering Software Co. In turn, Les passed it on to MicroSim, who sent the following letter to Les Dickenson.

"Dear Les,

Thank you for giving us the opportunity to review the article written by Jonathan Scott. We found it to be the most detailed and intelligent review of PSpice (and Spice for that matter) that we have ever seen. He might seriously consider submitting it for publication in a journal like Byte or EDN. The EE journals in the US could stand some detailed writing like this. Our compliments on a job well done.

Our only suggestions are as follows:

1) In the section on Parts he spells it, "parts" instead of "Parts".

2) His concern about the copy protection seems to be directed at our use of 5¼" floppy diskettes. As you know, we also offer a serial port security plug that allows the program to work on machines that do not have 5¼" diskette drives. (In fact, we no longer even ship the key diskettes, unless it is a special case.)

3) The cost of co-processors in the USA are: 8087 less than US$50, 80287 less than US$100.00.

4) The cost of our package is moderate, not high. Compared to other "PC" Spice programs (which are direct portations of the Berkely version), we offer performance ranging from two to 30 times faster. Compared to the "Mainframe" Spice offerings, such as H-Spice and IG-Spice, we charge less than a quarter of what they do. We also offer superior convergence relative to all of the above mentioned products not to mention technical support, provided free of charge to our customers.

As you can see, our comments are few. Again, thank you for letting us review the article.

Sincerely,

Michael Taggart
Director of Product Support."

Regarding Mr Taggart's comment in (1), the text was corrected prior to having the manuscript typeset. His comment in (2) is fair enough, but regarding (3), any reader who has looked at the price of coprocessors here lately (or bought one!) will realise how lucky they are in the US!

On the matter of cost, Mr Taggart probably makes fair comment. Without comparing its cost to competitive programs, many people or small companies would think carefully before purchasing PSPICE, which is the basis of Jonathan's comment. Incidentally, the cost here, compared to the US price, *is* moderate.

Roger Harrison

New generation videotapes

Inventors of the magnetic tape, BASF, has released a 'new generation' of VHS video cassette tapes which are reputed to offer consumers "outstanding brilliance and picture sharpness."

Coating density is being quoted at six million oxide particles per square millimetre of tape, thereby improving the quality of the magnetic media and the smoothness of the surface of the tape, according to BASF.

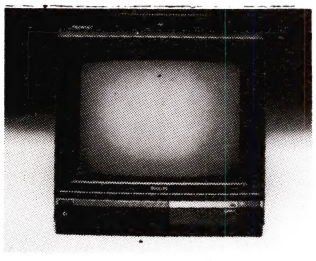
The colour brilliance, or chrominance, of the new tape is claimed to be 2 dB better than the superceded product, while the luminance is quoted as being 1.5 – 2 dB better.

Freedom from dropouts, seen as annoying white flecks or noisy bars on the screen, has been improved by 20-33%, BASF say. A special backcoating on the tape ensures mechanical stability as it passes through the machine's mechanism.

The new tapes are the Extra Quality (EQ) in the silver pack, Super High Grade (SHG) in black, and Super High Grade, High Fidelity (SHG HiFi) in gold livery. See your local BASF tape dealer.

New Philips TV with timer

Philips have released a new model portable TV which should provide the answer to every cranky dad's fondest dream – the ability to switch automatically from the kids' soapie to the news at a pre-determined time!



The in-built timer can switch the receiver on or off, or change channels exactly at pre-programmed times.

The 36 cm flat square tube remote control KH3647R also sports on-screen displays including a digital clock. The remote control handset docks snugly next to the foldable headphone set.

Equipment such as personal computers or hi-fi systems can be connected to the KH3647R through its RGB and video/audio I/O connectors.

Recommended retail price of the KH3647R is $779, from your nearest Philips dealer.

Further Beta development

Despite capitulating to market forces by finally marketing VHS machines (AEM March), Sony has continued to support Beta with the announce of the release of a new development of the format, ED Beta 625/50.

The new format is a PAL/SECAM version of the previously introduced Ed Beta NSTC-525/60. It is the first half-inch home use VCR to employ metal particle tape, achieves 500 lines horizontal resolution and features a high signal-to-noise ratio through greater deviation.

The format better maintains picture quality after editing by adopting a separate luminance and chrominance (Y/C) input/output signal method, Sony say. By this means, even third and fourth generation copies will show barely noticeable picture degradation.

The Ed Beta format considerably expands the FM signal frequency bandwidth for the luminance signal from 3.8 MHz- 5.2 MHz to 6.8 MHz-9.3 MHz, extending frequency deviation from 1.4 MHz to 2.5 MHz. In order to achieve maximum performance, a newly developed Tilted Sputtered Sendust (TSS) head is used.

Ed Beta VCRs can record and playback conventional Beta cassettes, although conventional Beta VCRs cannot use Ed Beta tapes. Accidental misuse of tapes is prevented by the inclusion of an automatic detection hole in the Ed Beta cassettes.

For further information, contact **Sony (Australia) Pty Ltd, 33-39 Talavera Road, North Ryde 2113 NSW. (02)887 6666.**

New digital audio cable

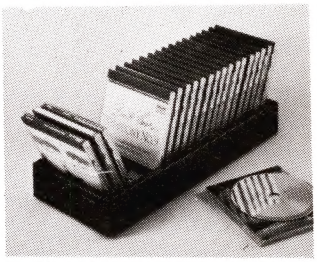
Audiophiles need despair no longer over losses between source devices such as CD players and their pre-amp. Audio Investments has announced a new range of SAEC Digital Audio Interconnect cables which offer what they claim to be "virtually flawless transmission characteristics."

The cables are manufactured by a process known as Ohno Continuous Casting (OCC), which is claimed to produce a "single crystal, free of grains and bubbles."

They are of coaxial design, and feature 24k gold plated non-magnetic phono plugs, designed to provide low values of capacitance, inductance and resistance.

These low values do not unfortunately extend to the recommended retail prices, which range from $129 for the 0.8 m 1702 cable to $299 for the top-line 1.6m 1707 cable. Prices are per pair, but do not include a matching CD player.

The SAEC cables are distributed by Audio Investments, and available through specialist hi-fi retailers.



CD storage system

Discwasher has developed an innovative new system for storing compact discs efficiently, while allowing easy scanning of the titles.

The CD Storage System measures 150 mm wide by 380 mm long and only 50 mm deep, yet stores up to 20 CDs in their cases.

The compact size and light weight make the system well suited to use in the home or car.

Recommended retail price is $34.95. For information on your nearest retailer, contact **Arena Distributors P/L on (09)361 5422**

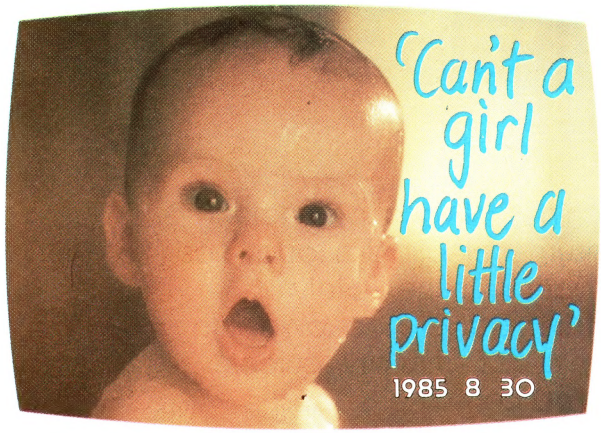
New V 8 format

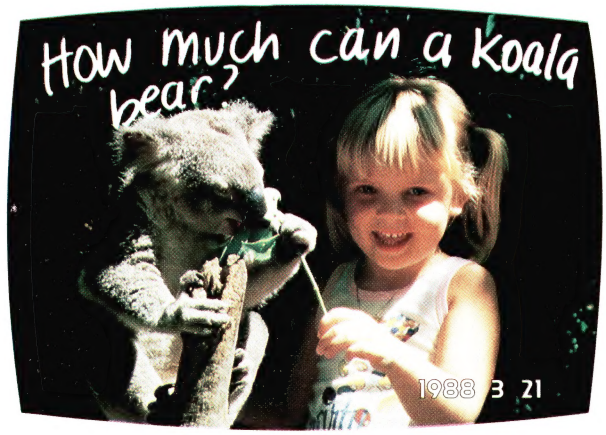
Agreement has been reached on the specifications for an 8 mm "Hi-band" VCR recording format, following technological developments in the area.

Participating companies Aiwa, Canon, Hitachi Maxell, Fuji, Konica, Matsushita, Sanyo, Sony and TDK announced the specifications, and will be submitting them for filing to the Electronic Industries Association of Japan (EIAJ), the body charged with administrating format related issues.

The format will be offered as a high-resolution option to current Video 8 in much the same way as the PCM audio system is offered as an option.

SONY





Another innovation in video from Sony. Words.

A good eye and a steady hand can make a passable home movie.

The Sony V50 Video 8 Handycam can make it unique.

It digitally superimposes titles of your choice.

Or graphics, designs, borders, logos or credits.

In a choice of eight colours and in any language.

Adding a creative yet personal touch to your memories.

And while what you decide to superimpose is up to you, it's reassuring to know that the rest of the movie-making process has been left to Sony.

There's no need to focus or allow for white balancing; the Sony V50 Handycam does it automatically.

It has a flying erase that gives consistently clean edits, playback capacity through the viewfinder or directly through your television, hi-fi sound and up to three hours recording time on each tape. Not to mention a date and time insert function and 6x power zoom lens with macro feature.

In fact, our Handycam is such an innovative little movie-maker that all you have to supply is the pictures.

Australia 1788 1988

Handycam DIGITAL
Video 8

CCD-V50

SNY 076

Video camcorders; VHS vs 8mm – it's consumers' choice!

Malcolm Goldfinch

With a total some 200 million video recording machines, of various formats, in homes around the world the hottest product in consumer electronics today has to be the video movie camera/recorder, or camcorder. With the variety of models now growing almost monthly, and prices falling steadily, coupled with the fact that over 60% of Australian households own a VCR, industry sources predict significant growth over the next few years. It's a consumer's "feast". Here's how to cruise the smorgasbord.

AEM HAS ALWAYS ADOPTED an even-handed approach to the protagonists in the never-ending battle of video formats. We devoted some seven pages to the advent of the 8 mm video format (V8) in the November 1985 issue. Last year, the "VHS camp" of manufacturers and distributors got together in a promotion of the C-format, following which VHS-C camcorders hit the market with a vengeance and now dominate the market. I would now like to examine what's happening with the market, with a particular look at VHS-C camcorders now that the "battle lines" have well and truly been drawn.

There is a marketing axiom that runs something like this: "Man with better mousetrap went broke because he was told people would beat a path to his door, but no-one told him an unknown mousetrap was NO mousetrap."

For nearly three years the VHS-C video format has been the unknown "better mousetrap" for most of the 150 million VHS VCR users who are going to, or may go into home video by adding a camcorder to their video systems. Surveys have shown that less than 2% of video users are aware that there is any significant difference between V8 or VHS-C format camcorders.

The V8 format was heralded by trumpets for three years before it arrived on the shop counter. After many conferences there was an impressive list of 127 manufacturers accepting the final 8 mm video format in March 1983 when, led by Sony, camcorders first went on sale overseas.

Even though JVC, the originator of VHS (Video Home System format), had joined those approving the new V8 format, they wanted to see what reaction there would be to a VHS design that offered all the size and weight advantages of V8, with the only limitation being reduced recording time of only one hour.

At an overseas Consumer Electronics Show early in 1985, JVC unveiled the GRC-1 VideoMovie, which used the "C" (Compact) version of VHS. This was the first of the now famous GRC model camcorders – now up to GRC-11. It was an instant sensation, being less weight than full-feature V8 camcorders – a mere 2.5 kg with cassette and battery. Above all, it would replay instantly in any VHS VCR with the cassette shell adaptor.

Market Area	VHS	VHS-C	VIDEO 8	COMBINED VHS
Americas	55	25	20	80
Japan	20	53	27	73
Europe	15	42	43	57

TABLE 1: Camcorder sales by major world markets in % (as at Jan. '88).

Panasonic's new M7 camera was only released weeks ago and is a successor to the M5. It is a top-line, fully- featured camcorder with a variable speed electronic shutter and requires full-size VHS cassettes. It's VHS-C "companion" is the MC7.

With a maximum recording time of 30 minutes in Standard Play (now extended to 60 minutes Long Play) it couldn't match the 90 minutes recording time offered by the PAL V8 format. However, consumer use has shown that this relatively short duration is not a major factor in home video movies. After all, the old Super-8 movie films were only three minutes per standard reel. Long duration recording is only important in time-shifting TV programmes, and Kodak proved that this was not an acceptable application for the V8 format.

Overshadowed by the tremendous hype generated for V8, VHS- C dozed along for almost a year. Most sales were in Japan. None of the other VHS supporters seemed ready to salute the VHS-C flag. Now enter the maverick – the full-size VHS camcorders, such as the Panasonic M5 and M7 (AEM Jan. '88, p.12), and similar Hitachi models. They are very small, light camcorders considering they are built around the full-size VHS cassette.

They enjoyed particular success, predicted by this writer who always carries a heavy portable VCR when travelling. The VHS camcorder is the perfect answer for the lonely traveller. It fits in a business case and allows the playing of

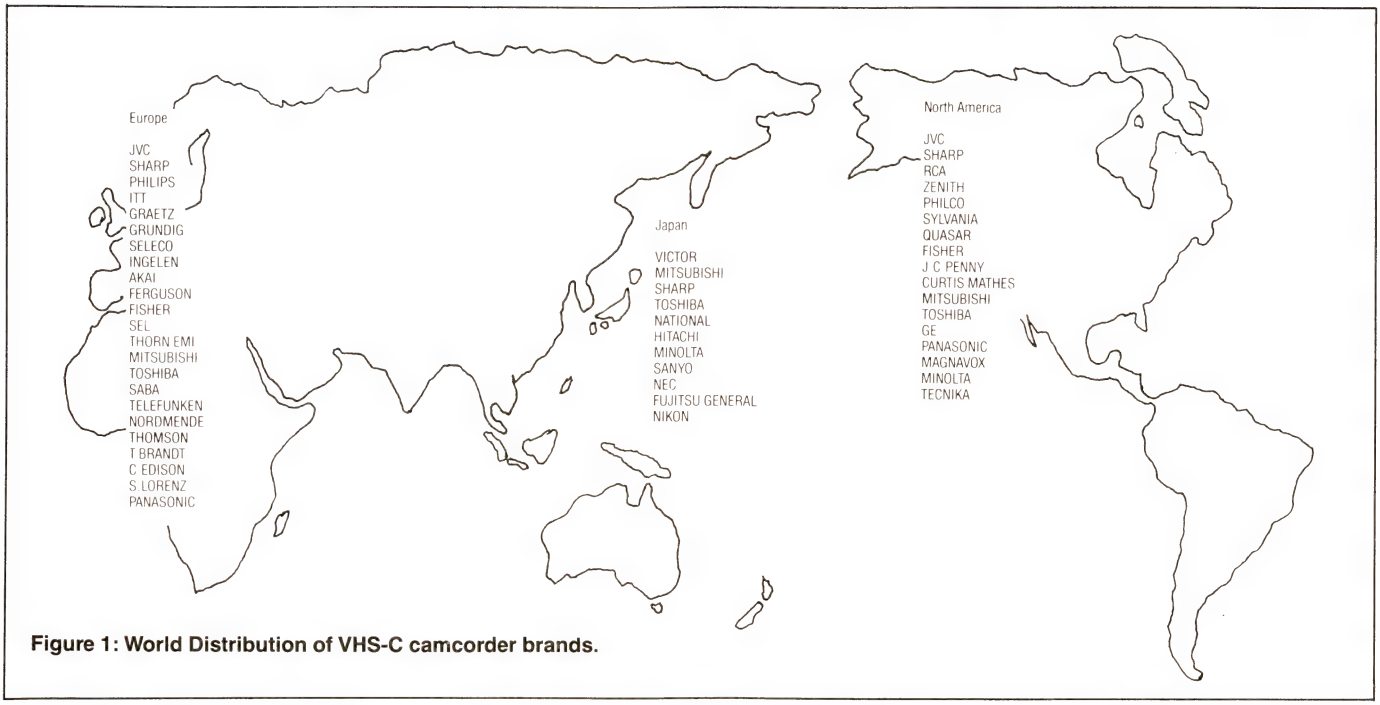


Figure 1: World Distribution of VHS-C camcorder brands.

rented videos on hotel TVs, or even the day's business footage.

Consumer power asserted itself. Marketing people can be very dumb. Against many predictions to the contrary, full size VHS camcorders still sell very well, and are favoured as a means of business communication because VHS is the universal standard. It is the continuing popularity of the full size VHS camcorder that has allowed the V8 supporters room to 'play statistics' with their percentage share figures of the camcorder market.

In good faith, perhaps, claims were made in Europe and elsewhere last year that V8 was the most popular format. At the Paris Photo Show 55% was claimed, and at the Hi-Fi and Video Show in Berlin undisclosed "pundits" claimed 57% share for V8 in the mini-camcorder stakes.

As these figures were quite at odds with information I had received from other parts of the world, I obtained the latest figures for camcorders shipped from Japan, where they are all made. These figures are meticulously recorded by MITI, a government body.

Table 1 shows the world market shares as at late January. The principle of "lies, damn lies and statistics" applies well here. By eliminating all the full size VHS camcorders, and inserting the prefix "Mini" before "Camcorders", the situation can be made to appear quite different.

Since the claims were made the V8 market share has been falling rapidly, as reflected by these figures, which are the latest available. In the Americas, where roughly half of all sales are made, VHS is by far the leader in camcorders, with a 55% share. VHS-C adds a further 20% for a total of 80%, with just 20% left for V8. If the current decline continues, it looks as though V8 will lose its deposit by 1999! Jokes aside, it seems that, unless the camera companies get behind V8 once again, then V8 is destined to be a niche product. Not that that will worry Sony, for that's their market strategy anyway – and they're the unquestioned leaders in V8.

Sony produced this limited edition 8 mm camcorder, the CCD- AU200, just for the Australian Bicentenary. It sells for $1988! It provides up to three hours recording (a singular advantage of V8), auto-focus, backlight correction, linear auto white balance and an auto iris. As with all of Sony's V8 Handycams, it is a record-replay machine. It weighs-in at 1.7 kg with battery and cassette included.

Formats and the market

There are at least ten Australian suppliers of VHS-C camcorders. Akai, JVC, Panasonic, NEC, Philips and Sharp have formed a cooperative to advertise and promote the awareness of compatibility of VHS-C with existing VHS VCRs. Toshiba, Telefunken, ITT and Nordmende also supply VHS-C camcorders and accessories.

Video 8 camcorders are supplied worldwide by Bauer, Chinon, Almo, Fuji, Minolta, Nikon, Aiwa, Blaupunkt, Canon, Kyocera, Pentax, Sanyo and Sony, the latter seven being the Australian suppliers.

The greatest blow to V8 video was the shock announcement by Kodak that it had quit the 8 mm video format it had pioneered some four years earlier. The total Kodak stock was sold to a chain of US discount stores.

Readers of AEM have been well informed of the market dominance of VHS for some years now. I have often written of how I would like to test and review a Sony VHS VCR. I have the greatest respect for the Sony team of designers and manufacturers, who make most of the TV equipment I use as a standard for comparing all video outputs. Perhaps soon I will have my wish?

The map in Figure 1 shows how the VHS format is supported worldwide. As shown above, camera companies have been the main supporters of the V8 format, perhaps due to ▷

Kodak's lead. The question hanging heavily in the air is "Will Kodak drop the other shoe?" Will they offer VHS-C as their new camcorder format? I would guess that Kodak cannot afford to ignore the camcorder market, and where can they go to except VHS-C in order to stay in the lucrative home movie market they dominated in film? Only time will tell.

The implications of what is happening in the multi-billion dollar world of video rivals the recent stock exchange crash for magnitude and importance. A computing analogy would be for IBM to bite the bullet and adopt the Macintosh system, making it the world standard beyond dispute, and clone-proof through proprietry chips. They would have to admit that when Apple went mad and produced a graphics-oriented machine with a mouse five years ago, they leapt ten years ahead of all DOS-based PCs. All the cheap clones would be left out in the cold of the MS-DOS ASCII-land. The US may even then pay off its national debt by domination of the world PC market! It would make sense politically as well as economically.

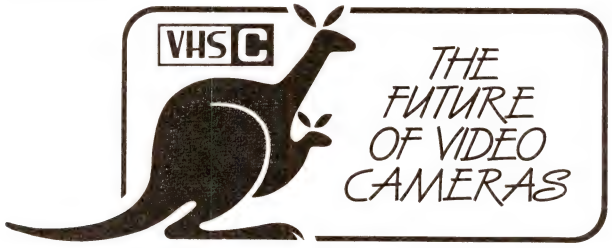
If Kodak's lead in V8 was the main reason for the world photographic manufacturers supporting that format, then their choice of VHS-C could see a sudden collapse of V8 as a viable format without the lingering agonies of Beta. The loss of investment in R&D, tooling, promotion and marketing for those involved could be quite catastrophic. For the consumer, the risk of backing the wrong horse again is very real and will in itself hasten an outcome decision.

Compatibility is the thing

It has only been in the last year that compatibility of VHS became a major factor in camcorder purchases. VHS has been the only truly compatible format for some ten years. Compact VHS started with the release of the full- feature CCD (Charge Coupled Device) imaging GRC-7. It offered more features and was smaller and lighter than any V8 camcorder.

Suddenly, VHS-C camcorders were in demand and in short supply around the world. There was a rush by VHS manufacturers to announce VHS-C camcorders. Some practised "badge engineering" and just put their label on the JVC GRC-7. The question was asked; "Why a new 8 mm video format if VHS will do?" The jury is still out with the verdict.

Recognising the problem of promotion and public awareness, press conferences on VHS-C were held last year around Australia. These were "ecumenical" gatherings of otherwise fierce competitors – the six VHS manufacturers mentioned earlier joined under the unifying symbol of mother kangaroo and her joey.



This consolidation of VHS manufacturers will promote awareness of VHS-C through advertising and special promotions. VHS claims to have a better mousetrap and they are at last going to generate some of the hype usually associated with V8.

The joey in the kangaroo pouch is an ideal PR symbol to quickly and simply show the most untechnical consumer what the "C" version of VHS is all about. Although the symbol was conceived in Australia, its success could well mean its adoption in a world-wide promotion.

The marketers are divided in their approach to the consumer. The majority, represented by the VHS consortium are saying "camcorders are an add-on to your VCR system, just as the VCR was an add-on to your TV." The minority is led by

JVC offers two simple cameras in its VHS-C VideoMovie lineup – the GRC9 and GRC11. The GRC9 is their equivalent in a video camera to the old Kodak "Box Brownie" of yesteryear. Weighing just 760 grams, it features one-button recording, full-auto, through-the-lens white balance adjustment and what is described as a "carefree Pan-Focus system".

The GRC11 is similar, but offers a 3:1 manual zoom lens, infra-red auto focus and zero frame editing. It weighs just 950 grams. The GRC9 shoots at light levels down to 10 lux, while the GRC11 shoots at levels down to 12 lux. Both cameras are record-only and have optical viewfinders. Maximum recording time is 60 minutes in long-play (LP) mode.

Sony, one of the major forces in the video manufacturing world, who until recently refused to make VHS gear for its customers – who were using more VHS gear every day. Sony's stand is "V8 is a whole new video world, making all other equipment obsolete. Buy a new V8 VCR for timeshifting TV programmes when you buy a V8 camcorder."

The original Sony V8 release reviewed by AEM offered the audio format of FM PCM hi-fi, which rivalled CD sound quality. It had its critics and I have not heard of it recently.

Choosing a camcorder

I will now spell out the considerations and options in acquiring a camcorder which will allow you, the consumer to be aware, and beware!

FORMAT CONSIDERATIONS

Followers of video wars have watched the life and death conflict of Beta vs VHS. The dealers and consumers gave Beta the thumbs down, yet all the consumer and video magazines said Beta was technically better – after all, it was chosen by most TV stations. Is it happening all over again? Why do the consumer magazines seem to get it wrong? The answer seems to be in the ageing of the products.

No laboratory can accurately simulate years of subtle domestic torture, yet this can be the only real test of value and quality. There were overtures about the beautiful complexity of Beta which left the tape over the heads during fast rewind. A marginal advance in quality when the product is new is irrelevant compared to better quality and reliability with age.

Consumers and dealers found the VHS format (designed for simplicity and reliability in the jam-fingered home) did it

BYE, BYE NATIONAL, HELLO PANASONIC!

National Panasonic (Aust.), in line with a world-wide move by its parent company Matsushita Electric, has dropped its long-established "National" brand name in favour of the name "Panasonic". The announcement was made at a company dealer's conference in Sydney recently which also celebrated the company's 10th anniversary in Australia. The announcement was made by Matsushita's president Mr Kiyoshi Seki who was in Australia for the conference.

It was explained that a major benefit of the name change would be faster access to new products, along with access to the complete range of Matsushita's products from Europe, the UK and USA. The Panasonic name previously appeared on National's office automation ('OA') and industrial electronic products. Coincidentally, 1988 is the company's 70th anniversary of its founding in Japan.

JVC's latest top-line VHS-C camera is the GR-45. It employs a new CCD image sensor that provides 390 000 pixels giving 400 lines of horizontal resolution. The GR-45 is a record-replay camera with all the latest "auto" features, an electronic viewfinder and a selectable high speed shutter providing 250th, 500th and 1000th second speeds. All this and you can edit in-camera.

better longer. Dealers are on the consumer's side, and love trouble-free evenings without complaints. They keep score cards. Thus did VHS conquer, and now the consumer and video magazines are again praising the complex and delicate against the robust and standard VHS-C – hardly choice advice. All this notwithstanding, marketing clearly played a significant role in the early success of Beta and the later rise of VHS, which now dominates the whole market.

But VCRs see much more service than video cameras, because they are used more frequently for replaying pre-recorded software and for time-shifting TV programmes. Head life, for both Beta and VHS, is typically quoted as 1000 hours, minimum. Typical performance betters that. With "typical" usage of maybe six hours per week, it would take around three years use to reach the 1000 hour limit.

Video cameras, on the other hand, might be lucky to see 100 hours usage over the same period! Head wear is hardly a consideration, regardless of the format. Robustness is more a question of usage and construction, rather than characteristic of a format.

Going against the grain, and with severe criticism from editors, I predicted the VHS win as far back as 1983. In this new arena, I'll venture it's hardly sticking my neck out to say that VHS-C will win the camcorder wars. The factors that weigh-in for this are: firstly, there are some 150 million VHS recorders world-wide – the great majority of consumers will stick with the same format; The marketing muscle of the VHS camp is considerable, certainly more united than the V8 group which does not have the wholehearted support of the camera/film companies now; and the cost of tapes.

On this latter point, 8 mm video tapes are twice or more the cost of VHS-C tapes. This is because 8 mm tapes are vacuum-deposited metal particle type, whereas VHS-C tapes employ the more familiar oxide type tapes. A 30 min. 8 mm tape can be bought for around $23-$24, while 30 min. VHS-C tape costs $10-$15. V8 tapes have the edge in recording time though, with up to three hours, where VHS-C is limited to one hour. Sixty minute V8 tapes cost around $27-$30, while 90 min. tapes are dearer again.

What will the reliability and standard of reproduction from an 8 mm format video look like in four years time, compared to that of a VHS-C with the same usage? No magazine can predict that with accuracy, but the Beta vs VHS example is on record. *Caveat emptor consumero, sapentia!*

CHOOSING

Regardless of format, there are feature options that apply to both. The cheapest or the mostest is the question. Generally, you get what you pay for. Top to bottom, you are talking about something over $2000 difference.

The full kit-and-kaboodle, at around $3000-$3500 gives you the lot in a glossy lock-up carry case, with moulded accessory compartments, pockets housing battery charger/ac supply, a rechargeable battery, a TV converter and connectors. VHS-C systems of this type would also house the all-important cassette shell mechanism which converts the "joey" compact cassette into the full "mother" size, for use in a standard VHS VCR. These items are also part of the cheaper packages, but are included loose. Of course, 8 mm camcorders have no need of such an accessory.

Camcorders can be broadly divided into two "streams" - the record-only type and the record-replay type. In the former, to playback what you have recorded necessitates removing the cassette from the camera and putting it in a VCR. If you already have a VCR, then by necessity, you have to get a camera compatible with that format. For record-replay cameras, it doesn't necessarily matter what type of VCR you have as the these cameras invariably provide a video output. In fact, a VCR is not even essential, unless you want to edit or dub your tapes.

The top camcorders include the EVF (TV viewfinder), which gives playback of the last few seconds when in record mode with the press of a button. This makes mugs almost professionals, as mistakes can be wound back and re-recorded on the spot. Many users consider this "instant playback" facility to be the crucial feature of video camera systems. Also included in sophisticated models you'll find: auto focus; auto white balance and compensation for natural, tungsten or in-between light; fading for special effects; and backlight lift. The lens systems feature power zoom by pressure sensitive switches and all light level iris control is handled by a light level microprocessor with the skill of Superman.

The latest camcorders of all prices should include the CCD electronic imaging sensor. Watch out for "bargains" using the old video tubes that eat battery power.

The cheapie: The smallest and cheapest camcorders, at around $1000-plus, will feature a plain optical viewfinder which does not allow instant playback on the spot. The view will be just like the old Super-8 movie cameras, where the image you see is what you hope to get on film, or in this case, tape. You see none of your results until you take the tape to a compatible VCR.

If you select such a record-only VHS camcorder, and have no VCR, then there are some playback only VHS VP (video players) available for about $300-$400 which will put your video on the TV screen. Sony also has some very attractive price reductions on full V8 VCRs with TV recording, when bought as a package with a V8 camcorder as part of their promotion of camcorders.

In between the top-of-the-line and the economy camcorders come the compromises. Auto focus and white balance without the TV viewfinder is a fair compromise in VHS-C as you can playback on any home VHS VCR. A TV viewfinder is more of a necessity with V8, where playback on handy VCRs is generally not available.

COMPATIBILITY

An important consideration in choosing the correct format for a camcorder is peer group compatibility. Can you use your home video cassettes on your friend's or relatives' VCR, or use ▷

theirs on yours? Do you really want to have to lug a special VCR to their house, or would you rather take just a cassette? If this is a factor, then bear in mind that the V8 format is not yet a common item in the home, as is VHS.

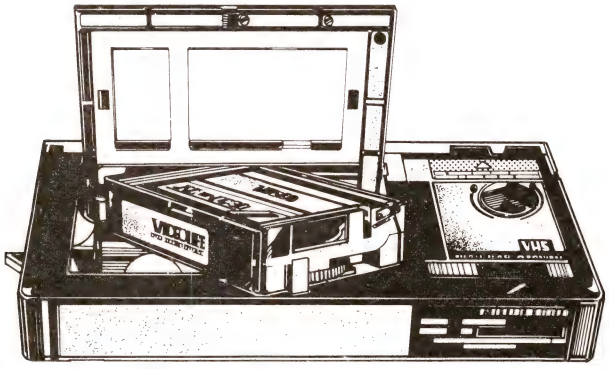


Figure 2: VHS-C to VHS adapter cassette

There can be no argument about VHS being the most compatible of all formats. As represented symbolically by the little kanga-joey logo, the adapter cassette allows the VHS-C user to use their cassette in any standard VHS VCR.

When I first saw the adapter over two years ago I described it as the ultimate gizmo. To use it, you release a catch at the front and the lid flies up. Next you drop in a VHS-c cassette and close the lid. It then buzzes and hums, vibrating in your hand, while the VHS-C tape is spread out by two arms until it matches the standard VHS cassette. Time elapsed for metamorphosis – four seconds. Move the catch again and the before the lid flies open it whirrs back to an easily removed VHS-C cassette.

QUALITY COMPARISONS

The same quality claim is being made for V8 over VHS-C as was made for Beta over VHS. On the whole, I find the quality of the two systems using new gear indistinguishable with an average home TV for playback. There are differences discernable under some conditions, particularly concerned with the reproduction of some colours – personal preference must be the arbiter here.

The quality of either is better than that of off-air recordings, and is all the average consumer could want, so picture quality of the new units is hardly a major decision point. The more-significant ageing comparisons will have to wait a few years.

It is important to understand that all formats now offer the HQ type of picture enhancement, which makes edit copy quality close to the originals. See that you get this feature in any good camcorder you buy.

OTHER CONSIDERATIONS

With Super VHS quality now exceeding many current professional video standards, VHS is now becoming the video equivalent of photographic world's 35 mm film. Despite this, most photo industry manufacturers are committed to the V8 format. Photo film giants have shown an apparent deathwish recently with disastrous excursions into abortive film formats. Remember such sizes as 127, 620, 126, 110, disc. Now they are hurting, but are safely back to 35 mm.

Little of this costly confusion could have happened if consumers were informed of the power-play facts behind these international format wars, but the last thing advertising seems to do when there is such a battle is to give the real facts and considerations. We try to do our best in presenting the information. Perhaps there will be a quicker and less painful end to the camcorder battle, with the facts now available to thinking consumers and their suppliers.

Many video manufacturers have the right to produce either VHS or V8 formats, but a lot of famous names are taking sides. The weight of manufacturing might seems to be moving behind VHS-C for camcorders. You have to choose a side when you make a camcorder purchase. This report may help you to make a decision, but the race is not yet run. Your judgement is paramount – the decision of who is victor and who is vanquished will be made according to where your money, and that of thousands of other consumers, will go. Hail consumer!

VARIABLE SPEED ELECTRONIC SHUTTER

This feature is now widely found on VHS camcorders. The "shutter" speed of a video camera is normally 1/50th of a second; that is, it shoots 50 frames per second. The charge-coupled device (CCD) picture sensor used on today's video cameras is an electronic device that allows high speed scanning of the picture falling on it. Scanned at higher speeds, the sensor can effectively provide "stop motion" recording permitting the camera user to capture fast movement that would otherwise appear blurry during playback.

To playback a recording in which the high speed shutter was used, you need to use a VCR with a "slow" or "super fine slow" playback facility. With the right VCR, you can stop individual frames of a high speed shutter recording and step through the action for a clear view of what happened during the shot.

Apart from action shots, the variable speed shutter facility allows you to experiment with interesting variations, particularly with depth of field manipulation where a foreground object is in-focus and the background out of focus.

Initially, cameras only provided 1/1000th-second and 1/50th-second facilities, but cameras released recently offer 1/250th, 1/500th and on up to 1/2000th-second shutter speeds.

For background on the technique, see *National's "Stop Motion" Video Camcorder – the M5"*, on page 12 of our Jan. '88 issue.

FURTHER READING

V8 – the new 8 mm Videotape Technology" AEM Nov. '85, p.22; and AEM Jan. '86, p.28.

HQ Picture Enhancement, AEM Apr. '86, p.16.

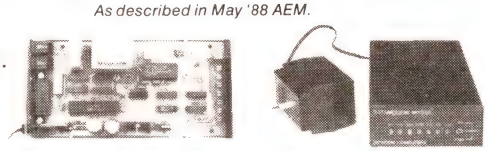
Full Size VHS Camcorders, AEM Jan. '88, p.12.

V8 Share of World Market, AEM Jan. '87, p.8.

Release of GRC-7 VHS-C Camcorder, AEM Sep. '86, p.10.

BUILD THE DATAMODEM M1200 MODEM.

As described in May '88 AEM.



KIT: $199.00 tax paid, $179.00 ex. tax

Ideal for "starters". Features 300/300 and 1200/75 speeds and a constant speed converter for computers that don't run split speeds (C64, IBM PC etc). Quality pcb and predrilled and painted metal case. Assembly and test manual inc. Kit includes power pak.

Phone plug sets and RS232 cables available. We take Bankcard, Mastercard and Visa. Free catalogue.

DATACOM COMPUTERS, Private Bag 39, Bayswater 3153 Vic.
Phone orders only on (03)90 1661.

Panasonic

Even more than you expected

M7

VHS Movie Camera
with Auto Focus for
Recording and Playback

Panasonic's Piezo Auto Focus, CCD Image Sensor, and 1/1,000-sec.; 1/500-sec. High Speed Shutter make shooting easy, even in difficult conditions.

NV-M7A
VHS Movie Camera

PROFESSIONAL QUALITY AT DICK SMITH ELECTRONICS

6.5MHz CRO

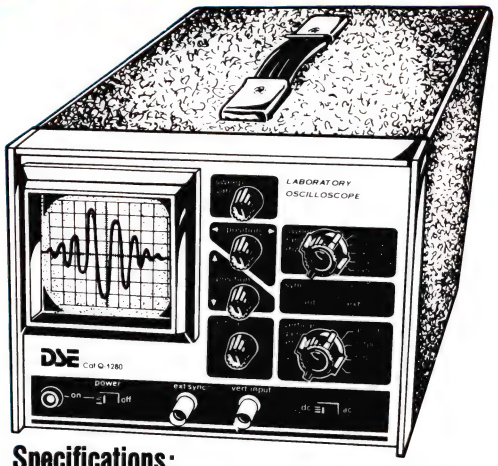
Every hobbyist knows how valuable a good oscilloscope is: probably the most useful piece of test gear you can own.

Hear's what it offers:

- Retrace blanking for a much clearer display
- 10mV per division vertical sensitivity
- 250mV/division external horizontal sensitivity
- 10Hz to 100kHz, plus external timebase
- Internal or external sync
- Useable response to beyond 6.5MHz

Ideal for the shack, the work bench, in service work, in the classroom and also in assembly applications. Solid state electronics (apart from the tube!) means fast warm-up and extremely low drift. Cat Q-1280

$399

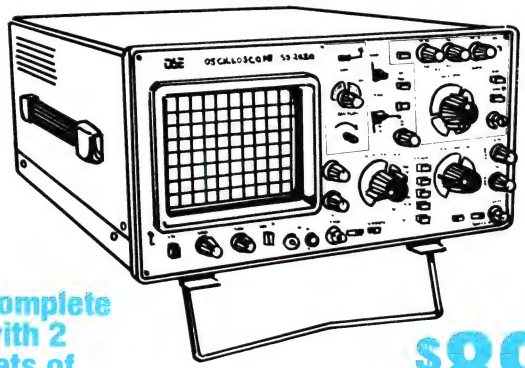


Specifications:
Vertical bandwidth: DC to 6.5MHz (−3dB)
Attenuator: 1/1, 1/10, 1/100 and ground
Horizontal sensitivity: 250mV/div or more
Timebase: 10Hz to 100kHz
Sync: External or internal
Input Impedance: 1 Meg//35pF

Dual Trace CRO — 20MHz

With Inbuilt Component Checker

You could buy one of those big-name oscilloscopes (the ones with the big-name price tags) and you probably wouldn't get all the features of the DSE CRO. It's a fully professional quality dual trace model offering outstanding performance for the price!



Complete with 2 sets of probes!

$899

Features:

- 20MHz bandwidth (−3dB)
- Use in single or dual trace mode
- Dual trace in chopped or alt mode
- Complete with 2 probe sets
- Inbuilt component checker — for capacitors, inductors, transistors, diodes, zeners, etc.
- And much, much more!

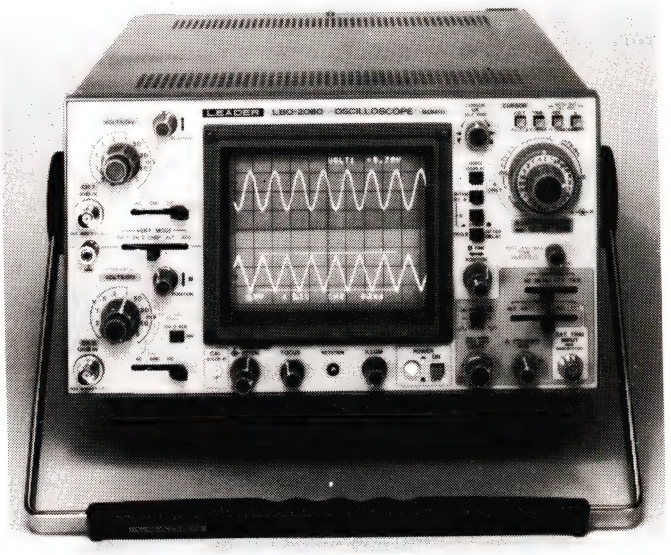
Cat Q-1260

Specifications:
DC-20MHz (−3dB), with less than 17.5ms rise time and 3% overshoot
Deflection: 5mV/div to 5V/div in 10 calibrated steps (1-2-5 sequence)
Accuracy: ±3%
Timebase: 0.1us/2V/div to 2/div in 20 calibrated steps (1-2-5 sequence)
Uncalibrated control to at least 5/div
Triggering modes: peak or normal from either/both channels or external
Trigger Sensitivity: 0.5V/div
Sweep delay: 0.1us to 10ms in 6 steps.

DICK SMITH ELECTRONICS

• **NSW** • **Albury** *21 8399* • **Bankstown Square** *707 4888* • **Blacktown** *671 7722* • **Bondi Junction** *387 1444* • **Brookvale (Warringah Mall)** *93 0441* • **Campbelltown** *(046)27 2199* • **Chatswood Chase** *411 1955* • **Chullora** *642 8922* • **Gore Hill** *439 5311* • **Gosford** *25 0235* • **Hornsby** *477 6633* • **Liverpool** *600 9888* • **Maitland** *33 7866* • **Miranda** *525 2722* • **Newcastle** *61 1896* • **North Ryde** *88 3855* • **Parramatta** *689 2188* • **Penrith** *(047)32 3400* • **Railway Square** *211 3777* • **Sydney City** *267 9111* • **Tamworth** *66 1711* • **Wollongong** *28 3800* • **ACT** *592 2366* • **Essendon** *379 7444* • **Footscray** *689 2055* • **Frankston** *783 9144* • **Geelong** *43 8804* • **Melbourne City** *670 9834* • **Richmond** *428 1614* • **Ringwood** *879 5338* • **Springvale** *547 0522* • **QLD** • **Brisbane City** *229 9377* • **Buranda** *391 6233* • **Cairns** *311 515* • **Chermside** *359 6255* • **Redbank** *288 5599* • **Rockhampton** *27 9644* • **Southport** *32 9863* • **Toowoomba** *38 4300* • **Townsville** *72 5722* • **Underwood** *341 0844* • **SA** • **Adelaide City** *232 1200* • **Beverley** *347 1900* • **Darlington** *298 8977* • **Elizabeth** *255 6099* • **Enfield** *260 6088* • **WA** • **Cannington** *451 8666* • **Fremantle** *335 9733* • **North Perth** *328 6944* • **Perth City** *481 3261* • **TAS** • **Hobart** *31 0800* • **NT** • **Stuart Park** *81 1977*

New CRO features numeric display



Leader's new LBO-2060 is a delayed sweep dual-trace oscilloscope that features a basic vertical spec. of 60 MHz/5 mV and on-screen display of VOLTS/DIV and TIME/DIV as well as numeric readings of waveform amplitudes and periods.

Other major features include: ALT TRIG function to obtain stable display of two asynchronous signals; built-in trigger pick off circuit; variable hold- off time; buffered output of CH1 input for further measurement; built-in signal delay line; and one-switch x10 MAG.

AWA, who are distributing the LBO-2060, claim that these features make it ideally suited for inspecting and servicing TV receivers, VTRs and computers.

AWA Distribution may be found at **Unit C, 2-8 Lyon Park Rd, North Ryde 2113 NSW.**

SIMM sockets from Utilux

Molex's new line of Single In-line Memory Module (SIMM) sockets from Utilux are designed to improve production flexibility and save pc board space.

Compared to conventional DIP mounting techniques, the SIMM modules are claimed to offer more efficient contact, tighter packing, simplified assembly, faster layout, easier memory upgrades and more options for configuration in many different circuit sizes.

For more information contact the nearest Utilux office or their Electronics Division at **14 Commercial Rd, Kingsgrove 2208 NSW. (02)50 0155.**

Fischer products from A. P. Imports

Fischer Electronic products from West Germany are now available from A. P. Imports. Fischer offer an extensive range of heatsinks in many styles, including extruded profiles as well as versions for power semiconductors, transistors in plastic cases, clip-on, U-shaped and Set-up heatsinks for semiconductors.

Heatsinks are available in either black anodised or aluminium matte etched. Extruded heatsinks are available in lengths from 50 mm to one metre, with a variety of mounting hole positions.

For further information, contact **A. P. Imports, 41 Box Road, Crossroads 2170 NSW. (02)600 9722.**

Shure classic mic re-release

Nostalgia has struck a heady blow with the release of the classically-styled Shure model 55SH Series II microphone.

Identical in appearance to the old favourite Shure 55S Unidyne, the 55SH features new interior components which Shure claim result in greatly improved frequency response, symmetrical cardioid pattern, distinctive presence peak and reduced stand-transmitted noise.

The 55SH offers low impedance output, a new cartridge shock mount for reduced stand noise, and adjustment through a wide range of tilt settings.

The new Shure 55SH Series II is said to be ideal for high quality PA or theatre stage sound systems, broadcasting, recording or other applications where a stand mounted microphone with a classic look is desirable.

For further information contact **Audio Engineers P/L at 342-344 Kent St, Sydney 2000 NSW. (02)29 6731.**

New counter/timer

Tabor Electronics has introduced a fully programmable low cost counter/timer – the model 6010. Operating through three independent channels over a frequency range of 0.1 Hz to 125 MHz, it is claimed to provide thirteen different measuring functions.

An automatic trigger level function and a non-volatile memory for the front panel set-up are featured in the standard model.

Available options include a 1.3 GHz third channel, GPIB interface, and TCXO, OCXO and analogue output.

For further information contact **Parameters P/L, 25- 27 Paul St, North Ryde 2113 NSW. (02)888 8777.**

Amber gain Swintek

A significant increase in Amber Technology's product range has been facilitated by the acquisition of a distributorship of Swintek products.

Swintek manufacture a range of broadcast communications equipment including radio microphones and headsets, designed specifically for TV news gathering and OB applications.

Swintek's patented DBS "audio scaling" signal processing equipment and their diversity antenna systems are are aimed at TV station and stage applications.

Amber intend to market the range of communications equipment to fast-food chains, theatre and stage productions, auditoriums and concert halls.

For further information contact **B. Detheridge, Amber Technology, PO Box 942, Brookvale 2100 NSW. (02)975 1211.**

New SinePro UPS

Uninterruptable Power Supplies are intended to keep vital computer systems, PABXs and control and monitoring equipment on-line and functioning correctly during power failures.

The new SinePro offering from Topaz provides all this as well as filtering out electrical noise, spikes and surges during normal mains operation.

Maximum backup time is limited only by the number of external batteries connected to the unit. Recharging is accomplished through the in-built 3 A or 6 A selectable charger.

In the event of a blackout the SinePro automatically switches to battery backup and begins supplying standby sine wave power within 4 milliseconds.

The SinePro UPS is distributed by **Online Control P/L, Unit 2/7 Waltham St, Artarmon 2064 NSW. (02)436 1313.**

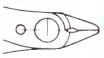
YOU WON'T BEAT THE QUALITY OF

Famous Hand Tools

PIERGIACOMI MADE IN ITALY SUB

Around the world, Piergiacomi tools are known for their outstanding quality and reliability. They're the choice of professionals — and now DSE has available this superb range. Expensive? Yes, they do cost more than our hobbyist range: but once you feel the quality, feel the precision, you'll realise they're worth every cent! There's a Piergiacomi for every purpose... all tools feature heavily insulated handles with sprung action blades and locking bush.

Cutting Nipper with back-angled cut



Designed especially for pcb soldering work. The cutting edge is on the opposite side to normal allowing a 1mm pigtail to remain ready for soldering — or allowing clearance of the soldered joint if you trim the pigtails after soldering. Clever — and it works! Blade opening 7mm, handles up to 1.3mm copper wire. Cat T-3261

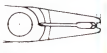
$16.95

Cutting Nipper with standard cut

Ultra-precision cutter with standard angled blades allowing completely flush cutting. Special safety feature: sping in blade prevents flying pigtails. Blade opening 4mm, cutting capacity 1mm copper wire. Cat T-3262

$16.95

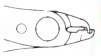
Inclined Frontal Cut Nippers



Very easy to handle, allowing leads to be cut 1.5mm from plane — perfect for soldering or to clear soldered joint. The blade tip is angled at 30° to allow access to tight spots. Blade opening 9mm, cutting capacity 1mm copper wire. Cat T-3263

$19.95

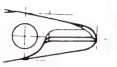
Inclined Cutter and Bender



Two birds with one stone! Not only cuts the pigtail, but bends it away from pcb so the component won't fall out. Fantastic! Makes pcb assembly a breeze — and solves one of the biggest bugbears of hobbyists! Blade opening 6mm, cutting capacity 1mm copper wire. Cat T-3264

$18.95

Shears



For larger cutting jobs — like mini scissors but with extra strength needed to get through metal, plastics, etc. 18mm length blades means they'll handle coax cable, etc. Blade opening 10mm, cutting capacity 1.6mm copper wire. Cat T-3265

$22.95

Needle Nose Pliers

Tweezer-like ends for reaching into almost inaccessible places — and flat blades so delicate components won't be damaged. 40mm long blades with 15mm opening at end. Cat T-3266

$17.95

Flat Nose Serrated Pliers

Fine (2.5mm) ends with serrations along blade mean extra grip when you really need it. 12.5mm opening with 40mm long blades. Cat T-3267

$16.95

Mini Drivers

Mini is right! Just the size for precision models, turntable cartridges, etc. At our low prices you can afford to buy a couple in case you lose one!

Flat Blade: Cat T-6010
Philips: Cat T-6015
Size: L 30mm
D 1.6mm H 25 × 7mm

95¢ EACH

Stubby Drivers

Great for confined space — or that tough screw which needs extra muscle. You can really get a grip on these!

Flat Blade: Cat T-6020
Philips: Cat T-6025
Size: L 38mm
D 6mm H 45 × 30mm

$1.95 EACH

Standard

Ideal for general purpose electronic work. Spot-on for ⅛ whitworth!

Flat Blade: Cat T-6030
Philips: Cat T-6035
Size: L 75mm
D 3.2mm H 57 × 15mm

$1.95 EACH

Medium Duty

Big enough to get a good strong grip and plenty of leverage. Add this to the rest of the range and you've got the right tool for just about any job.

Flat Blade: Cat T-6050
Philips: Cat T-6055
Size: L 150mm
D 5mm H 6.5mm
Handle: 95 × 25mm

$1.95 EACH

Heavy Duty

Everyone needs a big gun sometimes! Strong enough for the toughest work — ideal for the tradesman.

Flat Blade: Cat T-6060
Philips: Cat T-6065
Size: L 200mm
D 7mm H 100 × 25mm

$3.95 EACH

SCOPE Irons

Miniscope

Lightweight and a delight to handle and use, the Miniscope is perfect for general service work, kit building, etc. Finger tip control gives precise temperature — the equivalent of irons in the 10 to 70 watt range. Use Scope transformer for correct operation. With spare tip and element. Cat T-1660

Needs 3.3V @ 30A. Scope Transformer Cat T-1692 $59.95

$59.95

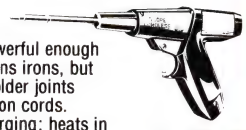
Superscope

The world-famous Australian! Scope irons are ideal for the hobbyist, the work bench, the lab — everywhere. Because they're made tough to take it, they can! Huge 150 watt capacity and it delivers heat from cold in just six seconds. You dictate the temperature you want. Stainless steel non-corrosive barrel. With spare tip and element. Cat T-1605

Needs 3.3V @ 30A. Scope Transformer Cat T-1692 $59.95

$52.95

Scope Cordless Solder Gun



For soldering where you want it. Powerful enough to handle the same jobs as 60W mains irons, but inbuilt NiCads give you up to 100 solder joints away from power points and extension cords. Includes plugpack for overnight charging; heats in just six seconds and takes standard Miniscope spares. Supplied with charger, two spare elements and two spare bits. Cat T-1600

$129

The Professional 'Pocket' Soldering System

The totally portable professional soldering system from Portasol. The equivalent of 10-60 watts of power with temperature adjustment up to 400° Celsius.

Just the thing for hobbyists, technicians, repairers... anyone who needs to make repairs, alterations, etc. on the spot! Cat T-1374

Look at what you get!

- **Pocket sized, temperature adjustable iron**
- **4 Tips including hot knife and blow torch!**
- **Tip cleaning sponge**
- **Heavy duty plastic case with clip-on iron stand**
- **Butane powered — refills in seconds**
- **Average 90 minutes continuous use**

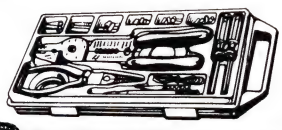
$79.95

Spare tip to suit Cat T-1375 **$12.95**

68 Piece Multipurpose Repair Kit

Already own a multimeter? This set has everything else — and then some! Auto electric checker (6-12-24V), heavy duty pliers, crimp terminal set... with 60 assorted crimp lugs, insulation tape, even connecting wire! A must for the hobbyist, technician — or even the motorist. Cat T-4834

$24.95

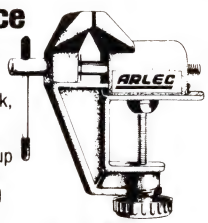


38 Piece Deluxe Repair Kit with Multimeter

Everything for quick and easy wiring repairs — with no soldering! Ideal for automotive and hobby use. Here's what you get: • Multimeter • Crimp Tool • Pliers • 2 Screwdrivers • Neo Tester (rated tp 500V) • Selection of crimp lugs. All in a handy, heavy duty carrying case. Perfect for throwing in the car — just in time! Cat T-4832

$39.95

Arlec Mini Vice



Need a third hand? Here's one that won't let go! The mini vice from Arlec attaches to any table, desk, bench, etc. (up to about 40mm thick). 50mm wide jaws hold tight — opens up to around 60mm for those big jobs. More than strong enough for cutting, filing and other testing applications. Cat T-4748

$15.95

DICK SMITH ELECTRONICS

MAJOR DICK SMITH ELECTRONICS AUTHORISED STOCKISTS: • **NSW** • **Armidale**: Sound Components, 244 Beardy St, 72 4981 • **Ballina**: Ballina Electronics, 102a River St, 86 7022 • **Bowral**: F.R.H. Electrical, 28 Station St, 61 1861 • **Broken Hill**: Hobbies & Electronics, 31 Oxide St, 88 4098 • **Charlestown**: Newtronics, 131 Pacific Hwy, 43 9600 • **Coffs Harbour**: Coffs Harbour Electronics, Shop 3, Coffs Harbour Mall, Park Ave, 52 5684 • **Deniliquin**: Deni Electronics, 220 Cressy St, 81 3672 • **Dubbo**: Chris's Hi-Fi, 1/100 Talbragar Street, 82 8711 • **Forster**: Forster Village Electronics, Shop 36, Forster Shopping Village, Breese Pde, 54 5006 • **Glen Innes**: John Sommerlad Electronics, Shops 5 & 6 Mackenzie Mall, 32 3661 • **Griffith**: Miatronics, 166-170 Banna Ave, 62 4534 • **Inverell**: Lyn Willing Electronics, 32 Lawrence St, 22 1821 • **Kempsey**: Drummond Home Entertainment, 38 Forth Street, 62 6265 • **Leeton**: Leeton Record Centre, 121 Pine Ave, 53 2081 • **Lightning Ridge**: Lightning Ridge Newsagency, 40a Morilla St, 29 0579 • **Lismore**: Decro, 12 Carrington St, 21 4137 • **Lithgow**: Douroy Photographics, 183 Main Street, 51 3173 • **Moree**: Moree Electronics, 26 Balo St, 52 3458 • **Mudgee**: Headware, 136 Church St, 72 3895 • **Nowra**: Nowra Electronics, 77 North St, 21 4979 • **Parkes**: Strad Music Centre, 279-281 Clarinda Street, 62 3366 • **Port Macquarie**: Hall of Electronics, The Horton Centre, 124 Horton St, 83 7440 • **Orange**: Fyfe Electronics, 296 Summer St, 62 6491 • **Springwood**: Wellington's Electrical Discounts, 132 Macquarie Rd, 51 4888 • **Taree**: Brad's Electronics, Shop 6, Civic Cinema Centre, Pulteney St, 52 6603 • **Tamut**: Tumut Electronics, 62 Russell St, 47 1631 • **Ulladulla**: Pauls Electronic & Hobby Toys, Shop 1, 10 Wason St, 55 2454 • **Wagga**: Phillips Electronics, 60 Forsyth St, 21 6558 • **Wellington**: Wellington Electrical Service, 110 Lee St, 45 2325 • **Young**: Keith Donges Electronics, 186 Boorowa St, 82 1279 • **VIC** • **Colac**: Colac Electronics, 215 Murrary St, 31 2847 • **Dandy**: Finders Pty. Ltd., 90 Broadway St, 68 1333 • **Morwell**: Morwell Electronics, 35 Holmes Rd, 34 6133 • **Shepparton**: Phillips Electronics Pty. Ltd., 137 High St, 21 9497 • **Warragul**: Roylaine Pty. Ltd, 16 Smith St, 23 4255 • **Warrnambool**: Marrtronics, Shop 12, Norfolk Plaza, 743 Raglan Pde, 62 9870 • **QLD** • **Bundaberg**: Bob Elkin Electronics, 81 Bourbong St, 72 1785 • **Caloundra**: Electro-Mart, 9 Tay Ave, 91 8533 • **Dysart**: Dysart Videotronixs, Shop 1, Jacaranda Crt Shopping Centre, Queen Elizabeth Drive, 58 2107 • **Kawana**: Splitec, Shop 5, Cartwright Centre, Nicklin Way, 94 7349 • **Mackay**: Stevens Electronics, 42 Victoria St, 51 1723 • **Maryborough**: Keller Electronics, 218 Adelaide St, 21 4559 • **Mt Isa**: Outback Electronics, Shop 71, Barkly Hwy, 43 3475 • **Nambour**: Nambour Electronics, Shop 4, Lowan House, Ann St, 41 1604 • **Noosa Heads**: Sunshine Phone Systems, Shop 6, Sunshine Bazaar, Sunshine Beach Rd, 47 4444 • **SA** • **Mt Gambier**: Hutchessons Communications Centre, 5 Elizabeth St, 25 0400 • **Murray Bridge**: Bridge Communications, 246 Adelaide Rd, 32 6476 • **WA** • **Albany**: Micro Electronics, 133 Lockyer Ave, 41 2077 • **Geraldton**: Batavia Lighting & Electrical, 98a Chapman Rd, 23 1842 • **Harvey**: Harvey Sales & Hire Services, 94 Uduc Road, 29 1819 • **Kalgoorlie**: Todays Electronics, 295 Hannah Street, 21 5212 • **Karratha**: Dave's Oscitronics, 1st Floor, Savings House, Hedland Place, 85 4836 • **Port Hedland**: Ivan Tomek Electronics, 30 Anderson Street, 73 2531 • **TAS** • **Burnie**: V.K. Electronics, 214 Mount Street, 31 7733 • **Devonport**: A.I. Electronics & Hobbies, 165 William St, Fourways 24 8322 • **NT** • **Alice Springs**: Farmer Electronics, 31 Elder St, 52 2388

DICK SMITH ELECTRONICS

Did you miss out?

Dick Smith Electronics' brand new 1988 Hobbyist and Enthusiast catalogue is now available in all stores! Call in for your FREE COPY now . . . or phone (02) 888 2105 or write to DSXpress, PO Box 321, North Ryde 2113 and ask for one to be posted!

Spray Freezer

Instantly freezes components to −50° Celsius. Ideal for cooling and servicing electronic/electrical components, shrinking shafts, bushes, etc. 350g spray can with nozzle. Cat N-1056

$6.50

Matte Silver Spray Paint

Anti-glare silver paint for a smooth, elegant finish to that special project. Quick drying paint is ideal for front panels, cases, etc. 150g spray can. Cat N-1076

$2.95

Heat Transfer Compound

From Electrolube, specialists in chemical service aids to the electronics industry. Heat transfer compound comes in 10ml syringe for easy application. Cat N-1200

Non silicon
Non metallic

$5.95

Permagard

Moisture Displacement

Displaces water and moisture, penetrates, lubricates and provides protection against corrosion. In 250g spray can. If you've already got some in the workshop — put some in the car! Cat N-1065

$7.50

Contact Cleaner Lubricant

Improves electrical contact, reduces wear, suppresses arcing, loosens sulphide and tarnish film, inhibits corrosion an maintains stable low contact resistance. In handy 300g can with spray tube. Cat N-1042

$7.50

MAINS

See-Through 3 Pin Plug

Same as 3 pin plug, but see through so you can see faulty or broken wiring, etc. Cat P-5401

$1.90

See-Through Line Socket

As for P-5401, but extension cord end. See through: for safety's sake. Cat P-5411

$4.30

Cordlock

Stops plugs and sockets pulling apart — it's dangerous and inconvenient. Added safety for your extension cords. Cat P-5412

$5.49

Suppressor Plug

Standard 3 pin AC plug, with capacitors fitted to reduce unwanted pops and crackles from audio equipment. Cat P-5425

$8.95

International Traveller Adaptors

Having trouble with power points overseas? Here's the answer! A neat little adaptor that converts our 3 pin plug to virtually anything used in the world. One piece (so you won't lose bits). Use active/neutral pins only: does not connect earth. Cat P-5652
N.B. Does not adapt voltage!!!

$24.95

13.8V @ 1.5A Regulated

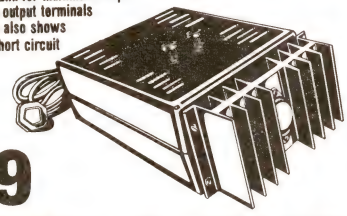
Just right for CB's, car radio/stereos, small amateur transceivers (hand-helds especially), etc. 13.8 volts DC regulated with terminals for easy connection. Makes a great service supply, too. Cat M-9545

$69.95

13.8V/4A Peak

For the 2m or small HF amateur transceiver, a supply for 'auto' equipment, even a bench supply for service work! With a 3 amp continuous (or 4A continuous at 75% duty cycle!) and a huge 8 amp instantaneous peak rating, it's ideal for those higher current and higher peak demand applications. Cat M-9547

- **Heavily heatsunk for maximum output**
- **Colour coded output terminals**
- **LED indicator also shows overload or short circuit**

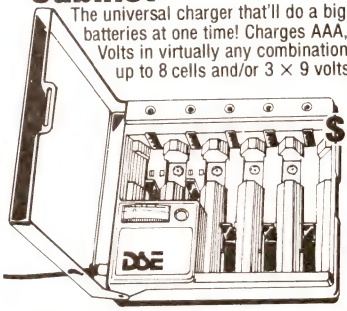


$99

Up to 8 batteries at once...

The DSE NiCad Charging Cabinet

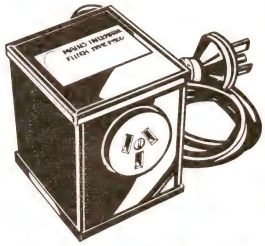
The universal charger that'll do a big bunch of NiCad batteries at one time! Charges AAA, AA, C, D and 9 Volts in virtually any combination. That's right up to 8 cells and/or 3 × 9 volts at one time. Cat M-9505



$39.95

Take Out Those Spikes and Sprugles From Your Computer!

Deluxe mains filter eliminates all the garbage from your computer for a clean line of supply. So if you're having 'crashing' problems this could be the answer! Rated at 240V, 2 amps. Cat M-9850
Energy authority approved.



$149

BATTERY HOLDER AND SNAP

Battery Holder

9V Chassis/PCB Mount. Cat P-6220

$2.95 WAS $3.75

Battery Snap

Suits 9V (216 size) batteries. Cat P-6216

25¢

DICK SMITH ELECTRONICS

• **NSW** • **Albury** *21 8399* • **Bankstown Square** *707 4888* • **Blacktown** *671 7722* • **Bondi Junction** *387 1444* • **Brookvale (Warringah Mall)** *93 0441* • **Campbelltown** *(046)27 2199* • **Chatswood Chase** *411 1955* • **Chullora** *642 8922* • **Gore Hill** *439 5311* • **Gosford** *25 0235* • **Hornsby** *477 6633* • **Liverpool** *600 9888* • **Maitland** *33 7866* • **Miranda** *525 2722* • **Newcastle** *61 1896* • **North Ryde** *88 3855* • **Parramatta** *689 2188* • **Penrith** *(047)32 3400* • **Railway Square** *211 3777* • **Sydney City** *267 9111* • **Tamworth** *66 1711* • **Wollongong** *28 3800* • **ACT** • **Fyshwick** *80 4944* • **VIC** • **Ballarat** *31 5433* • **Bendigo** *43 0388* • **Box Hill** *890 0699* • **Coburg** *383 4455* • **Dandenong** *794 9377* • **East Brighton** *592 2366* • **Essendon** *379 7444* • **Footscray** *689 2055* • **Frankston** *783 9144* • **Geelong** *43 8804* • **Melbourne City** *670 9834* • **Richmond** *428 1614* • **Ringwood** *879 5338* • **Springvale** *547 0522* • **QLD** • **Brisbane City** *229 9377* • **Buranda** *391 6233* • **Cairns** *311 515* • **Chermside** *359 6255* • **Redbank** *288 5599* • **Rockhampton** *27 9644* • **Southport** *32 9863* • **Toowoomba** *38 4300* • **Townsville** *72 5722* • **Underwood** *341 0844* • **SA** • **Adelaide City** *232 1200* • **Beverley** *347 1900* • **Darlington** *298 8977* • **Elizabeth** *255 6099* • **Enfield** *260 6088* • **WA** • **Cannington** *451 8666* • **Fremantle** *335 9733* • **North Perth** *328 6944* • **Perth City** *481 3261* • **TAS** • **Hobart** *31 0800* • **NT** • **Stuart Park** *81 1977*

Order by phone Toll Free (008) 22 6610 for DSXpress 24 hour Despatch.

Four new HP calculators

Hewlett Packard has long been associated with practical state-of-the-art calculators, and their recent release of two new scientific and two new business calculators certainly seems to confirm their market pre-eminence.

The HP-17B (B for "business") has a two line x 22 character display, and features popular business functions such as time value of money, unlimited cash flows, bonds and depreciation, curve fitting and an appointment menu with alarm clock.

The top-line HP-19B shares the features of its smaller cousin, but adds a four line display with graphics, histograms, currency conversions, text editing for name and number lists and other assorted functions.

The smaller of the two new scientific models, the HP-27S is designed for technical professionals in management. It has a wide range of scientific and financial functions, such as amortisation, forecasting, trig functions and statistics, and features a two line display.

The ultimate offering is the HP-28S advanced scientific calculator, featuring a four line display with graphics capabilities, 32K RAM and many advanced functions, particularly those concerned with the graphics functions and the creation of custom menus for special functions.

All four of the new calculators feature "HP Solve", a facility which is claimed to allow the entering of custom equations without programming. They also include an infrared light interface for cord-free connection to the optional HP 8224OA printer.

Various texts of business and profession-specific equations and solutions are available to suit each calculator. Personally, after all this time I still can't get used to the idea of HP calculators that include an "equals" key.

Recommended retail prices are as follows: HP-17B – $110; HP-19B – $338; HP-27S – $212; HP-28S – $454.

New distribution company

Obiat Pty Ltd has recently been founded by well-known industry identity, Len Altman,to act as a distributor of electronic and mechanical products from Australian manufacturers and importers.

General Manager, Len Altman, has had 35 years of experience in high tech electronics, the last 23 years of which have been in sales, marketing and management functions.

Obiat Pty Ltd has been appointed as an official distributor for many of the test instruments and components imported by Elmeasco Instruments Pty Ltd, a company which Len Altman helped co-found in 1967 and from which he stepped down as Managing Director in May 1987.

In addition to the products from Elmeasco, the company has also been appointed as NSW and Queensland prime distributor for the Angledale range of Australian manufactured adjustable motor mounts.

Obiat is also able to offer for immediate delivery, a wide range of used, but as new, test instruments and accessories at competitive prices.

Contact **Obiat Pty Ltd, PO Box 37, Beaconsfield 2015 NSW. (02)698 4776.**

New data acquisition products

Brumby Technologies P/L are galloping full speed into the data acquisition market with the release of a range of new products, including a 64- channel input module and a bus for linking PCs to external ICs.

The Lawson Labs Model 64 Digital Input Module is a digital multiplexer which allows any one of 64 channels to be read though a single digital input. They can be placed in parallel for wider data paths or in series to monitor thousands of points.

The LAB40 Local Applications Bus is a ribbon cable I/O bus claimed to minimise new product development time for add-ons to PCs. The bus is said to be ideal for chip evaluation, and includes such features as interrupts, DMA speeds and 16 data bits. Boards currently available for the bus include A/D converters, relay drivers, clocks and stepper motor controllers.

For more information, canter or trot into **Brumby Technologies P/L, 25 McCallum St, Lakemba 2195 NSW. (02)759 1638.**

Lighting and sound for EXPO

Jands Electronics have supplied substantial lighting and sound equipment for EXPO 88, being held at Brisbane from April until October.

Lighting equipment supplied included 750 Jands Par 64 Cans, specially designed for outdoor use, 180 Silhouette 1 kW and 2 kW profile spotlights, over 100 lengths of 8' Concert Truss and four custom truss-mounted follow spot cages.

Audio equipment included nearly 200 Jands power amplifiers, the first of the new Soundcraft Series 8000 Monitor Desks, talkback systems and a Clear-Com intercom system.

Congratulations to Jands for such a significant technical contribution to EXPO. Further information is obtainable from **Peter Twartz, Jands Electronics Pty Ltd, 578 Princes Hwy (PO Box 171), St Peters 2044. (02)516 3622.**

One year time switch

The recently released SC500, 4-channel electronic time switch from Anitech can be programmed for up to one year in advance. Even leap years are automatically catered for.

The 123 time points on four channels can be programmed by day of the week or by date, with switching priority given to date. All programs are automatically reset to daylight saving time if so required.

Manufactured to suit DIN-rail or surface mounting, the SC500 has three switching modes: on, off and impulse (one second). A backward or forward eight-position pre-selector makes choosing the mode of operation simple, from automatic; read/delete; program; time of day; date; cont. on/off; daylight saving time and running time.

After programming, the date and time of day are displayed on 10 mm high LCD digits. The SC500 is quartz controlled, with an accuracy of ± five minutes per year and has a battery reserve of greater than 100 hours at 20 degrees Celsius, Anitech claim.

For further information, contact **Anitech, 1-5 Carter Street, Lidcombe 2141 NSW. (02)648 4088.**

New audio filters

Port-A-Flex's new model ADO66-5 audio filter is claimed to be ideal for frequency dependent compression, limiting or expansion, optimisation of energy levels in live sound, and for enhancing the performance of noise reduction systems.

The ADO66-5 consists of two independent, critically damped roll-off filters which may be configured in high pass, low pass, band pass or band reject modes. Turnover point and slope of the filters are variable over wide ranges.

For more information, contact **Hi-Phon Distributors P/L, (02)417 7088.**

Placing loudspeakers for indoor and outdoor PA systems

Will Kennedy

Making sure the audience can hear clearly is the final goal of all PA and sound reinforcement systems. But many conflicting requirements are faced by those responsible for "organising the sound". Regardless of other considerations, placement of the loudspeakers will make or break the effectiveness of communication with the audience.

EVERYONE acknowledges that the object of sound reinforcement is to "get the message to the audience" – be it speech or music. Where sound amplification is essential, the audience must hear the speaker/band/orchestra/whatever with the best clarity obtainable and at the required level – too soft, and they miss out, too loud and they leave!

Before tackling the practicalities of placing loudspeaker systems for indoor and outdoor PA systems, it is instructive to know a little background – "theory", if you like – to sound propagation as it helps you understand why certain things are done the way they are and gives some insight into situations that will help you solve problems in practice.

Good vibrations

Sound propagates through the air from a vibrating source – the strings of a violin, the head of a drum, the cone of a loudspeaker, for example – by moving the air molecules to and fro along the direction in which the sound radiates. That is, by "longitudinal mechanical waves". Because the sound propagates in all directions, the "loudness" or sound pressure level falls off with increasing distance from the source.

Those with a mathematical bent will realise that the sound pressure level (or spl) should fall off according to an "inverse square" rule. That is, every time the distance from the source is doubled, the spl drops by half, or six decibels.

In fact, all sorts of complex mechanisms combine to confound this rule in many circumstances, particularly when indoors, and some losses lead to increasing attenuation of the higher frequencies with increasing distance. Fortunately for us, there are plenty of circumstances where the rule *does* generally hold.

Faith, hope and clarity

To re-state what I said in my introductory paragraph, a sound reinforcement system will give satisfactory results if the whole audience can clearly understand what is being played or said over the system, without having to consciously concentrate. This depends on satisfying a number of criteria.

Firstly, the sound level perceived by each listener must lie comfortably between two extremes. The loudest sustained level people will generally tolerate lies between about 80 and 100 dB spl, with peaks in the range 105-115 dB spl. A level of 90 dB is "pretty loud" to most people. The threshold of pain lies at 130 dB spl and levels above 120 dB can certainly damage hearing. At the other end, the sound must be at least 10 dB above any background or "ambient" noise.

Several other factors affect perceived clarity. With speech, or singing, consonants must be clearly heard – but this depends considerably on the announcer or performer and to a lesser extent on the microphones or system frequency response. In addition, any echo must be kept below a level where it interferes with clarity or becomes annoying.

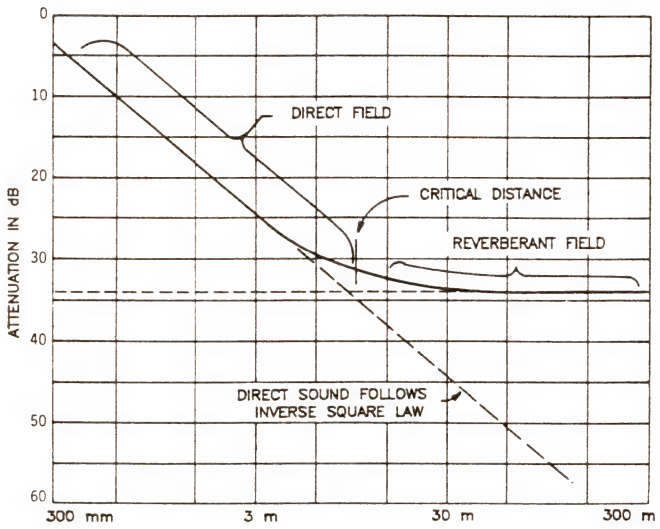


Figure 1. In a large room, the direct and reverberant sound fields add, giving rise to the curve shown. Beyond the "critical distance", the reverberant field dominates – and you're in trouble!

The effect on clarity is principally dependent on two factors: the time delay and the level of the reflected signal at the listening point. In any room particularly a large hall or theatre, naturally enough, you expect and get echoes from the walls, ceiling and floor. At some point in the room, the echoing or reverberant sound will match the level of the direct sound from a speaker or other sound source. Figure 1 shows how the direct and reverberant sound add, resulting in a sound attenuation curve like that shown.

Outdoors, if there are reflective structure nearby – a large building, hills, etc – then a similar effect is noted.

The time delay of the echo causes an "annoyance factor". Doak and Bolt in the US did some study on this and came up with a curve of the difference in spl between the primary signal and the echo signal versus echo time delay for "10% audience annoyance". This is shown in Figure 2.

For short time delays, the echo can be quite loud relative to the primary signal before it becomes annoying. With longer delays, an echo 20 or 30 dB below the main source can be significant.

Feedback

Some PA operators think feedback means when the audience yells "turn it up, turn it up!" No doubt you've all experienced at one time or another the *"howling"* that occurs when the ▷

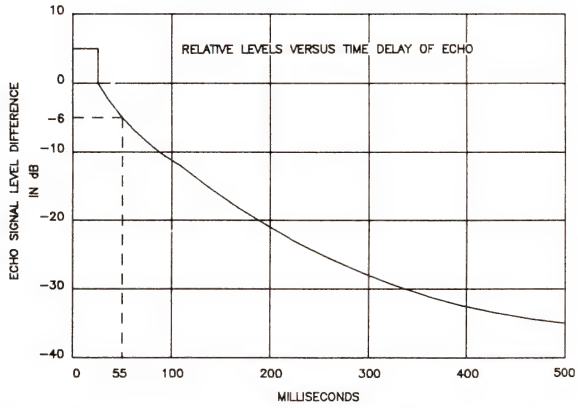


Figure 2. Doak and Bolt compiled this curve of echo level (relative to the primary signal) versus time delay of the echo for "10% audience annoyance".

microphone of any audio system is placed too near a speaker.

The whole audio system turns into an oscillator and comes about when the total gain of the system – mic/amp/speaker – exceeds a value of one. It usually occurs at one frequency, or perhaps a few dominant frequencies. A small peak or peaks in the frequency response of the system, which may be largely affected by the environment, will cause the feedback to occur on a single frequency.

"Howl round" or feedback is avoided by ensuring the level *and* phase of the sound reaching the microphone from the speakers meets the above requirement. When the system gain and phase does approach oscillation, "ringing" is apparent on the sound.

Speaker characteristics

In sound reinforcement or PA applications, the *dispersion* characteristic of the loudspeakers is high on the list of important considerations, quite apart from the usual requirements of frequency response, distortion and efficiency.

A speaker will cover an area in front of it that looks like an arc (or, more accurately, a cone) radiating from it.

A speaker with wide dispersion will cover a wide angle, while a speaker with narrow dispersion will cover a relatively narrow angle. All very obvious. Problem is, the dispersion of a loudspeaker may not be constant over its operating frequency range. If such is the case, the dispersion narrows with increasing frequency. Some manufacturers have worked on this problem and have produced "constant directivity" speakers that substantially maintain their dispersion characteristic over a wide frequency range.

Efficiency is important because, the higher the efficiency of a speaker system, the more "bang" you get for your "buck" – for a given amplifier power output, you'll achieve higher sound levels with higher efficiency loudspeakers. Typical "hi-fi" loudspeakers may have efficiencies of 2-3% , or less. For sound reinforcement applications, your looking for efficiencies of 25%! You have to "throw" that sound a long way.

For this reason, PA loudspeakers are some combination of a high efficiency/high output driver and a horn. The horn may have a cross-section that is square, rectangular or circular. Intrinsically, horns have a limited frequency response and their efficiency is inversely proportional to their bandwidth – high efficiency horns have a more limited bandwidth.

The shape of the horn is arranged such that its cross-sectional area increases exponentially away from the driver. "Short" horns have relatively low efficiency, but wide frequency response and wide dispersion, compared to "long" horns which have quite high efficiency but restricted frequency response and narrow dispersion. The horn may be "folded", which physically "shortens" it, only slightly reducing the efficiency, but providing better dispersion which is generally an advantage. The "straight" horn with its relatively narrow dispersion has a long "throw" and is often pressed into service to provide sound coverage in a "corridor" over long distances.

The familiar horns used in voice PA systems are generally folded types with a frequency response of typically 400 Hz to 5 kHz. "Concert" PA loudspeakers generally comprise a number of horn-loaded drivers with similar dispersion characteristics to provide the required frequency response.

In the great outdoors

Outdoor PA systems are predominently for voice. Typical outdoor venues are ovals, fields, parks or beaches and the area to be covered is generally well defined. In the first three cases, the ratio of the length to the width of the area to be covered is around two-to-one, or less. Such situations are ideally covered by placing a vertical "stack" of horns one above the other on a pole at a "short" end of the area, well away or furthest away from the microphone. Such a stack produces a horizontal "fan" of sound, rather than a cone, and avoids wasting output that would otherwise be thrown upwards.

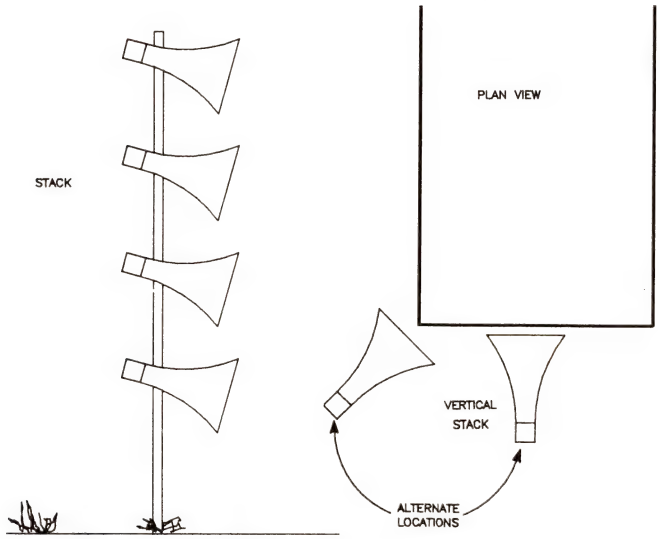


Figure 3. To cover a rectangular outdoor area, a stack of horns is placed in the centre of one short end, or in one corner. Angle the horns down for best coverage.

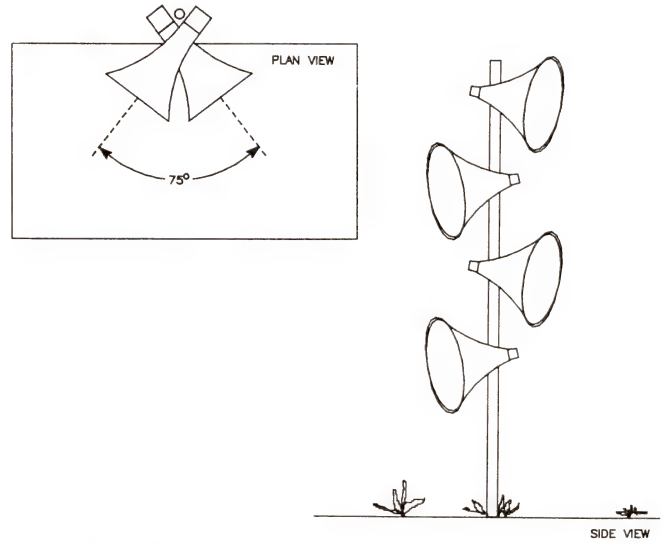


Figure 4. In situations where the stack needs to be placed on the long side of a rectangular area, angle each alternate horn about 70-80 degrees.

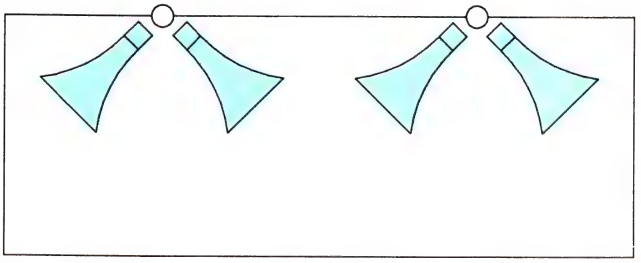


Figure 5. To cover a long, narrow strip, place twin horns at regular intervals, angled appropriately. They should be spaced 50 m for every 5 m of height at which the horns are mounted.

Figure 3 shows the general arrangement in plan and elevation. For best coverage of the area, the horns should be angled slightly downwards. Where a rectangular area is to be covered, the stack may be placed either in the middle of the short end, or at one corner. If the stack has to be placed on the long side, angle the horns at about 70-80 degrees, as shown in Figure 4.

Where a very large distance has to be covered, use a "long throw" horn or two at the top of the stack. You could place some small horns at a low height near the most distant areas if you need extra coverage.

This "central cluster" approach also works well with music sound systems at outdoor venues, providing you don't have to cover huge areas. The problems that arise in the latter case require solutions which are really beyond the scope of this article.

Where long, narrow areas are to be covered, such as a beach or river front, it is best to place quite a few horns at regular intervals along the area to be covered. You'll need fewer speakers if you mount them as high as possible. The rule of thumb here is that, you should space them about 50 metres apart for every five metres of height. Figure 5 illustrates.

Indoors, out of the weather

There is no doubt that the differing approaches to indoor sound systems will always create a great deal of debate. Preferences are born out of experience. However, there are some basic approaches that can be made to work quite well under a huge variety of circumstances.

For the sake of discussion, I'll categorise indoor venues into three classes: small, medium and large. So much for that! Then, there are two ways to approach the placement of the loudspeaker system: the "central cluster" and the "split stack".

The central cluster employs a full-range, multi-way speaker system "flown" above the stage. Drivers with suitable dispersion characteristics are arranged to cover the entire area, or stacks with narrower dispersion are arranged side by side to cover the appropriate area from the centre out, left and right. It's simple.

COLUMN SPEAKERS

So-called "column" speakers, where an array of direct-radiator drivers (ordinary cone speakers) are closely mounted one above another, date back to the late-20s when RCA used them in early motion picture sound systems. The vertical array concentrates the sound in a horizontal fan, reducing the vertical distribution.

POWERED SUB-WOOFERS FOR P.A.

Most compact professional speaker systems perform very well in the mid to high frequencies. Bass, however, is often a problem. One common solution is the addition of an independent sub-woofer system, tailored to handle only the lower frequencies.

Etone have recently announced the release of their EHT Bass Machine, a powered sub-woofer system for use with existing compact professional speaker systems.

The EHT Bass Machine is a self-contained unit consisting of a 38 cm bass speaker in a vented enclosure driven by an integral power amplifier via an electronic crossover with extensive signal processing functions.

Operation is particularly simple. To install the Bass Machine to an existing system the output from the mixer is disconnected from the input of the main system power amplifier and connected instead to the input of the Bass Machine. The output from the Bass machine is then taken to the input of the main power amplifier. The control on the Bass Machine is set to the desired level, and the installation is complete.

The complete system is then operated as before, controlled from the mixing console.

All the elements in the EHT Bass Machine have been optimised for best performance in the frequency range specified. Extensive signal processing and equalisation is used to extract the maximum performance from the system.

The main system speakers and amplifier are able to operate at greater efficiency because the crossover section of the Bass Machine removes the frequencies below 120 Hz from the main system signal. Since the main system is no longer required to process signals well below its optimum range, it can deliver considerably more usable mid and high frequency output.

The EHT speaker likewise works at maximum efficiency as all signal components above 120 Hz are filtered out of its input, eliminating unwanted subsonics, preventing distortion through input overload and eliminating damage from either excessive cone movement or voice coil overheating.

A typical sound system running around 150 – 250 watts generally needs only a single EHT Bass Machine. Dimensions are 625 x 490 x 390 mm, weight is 28 kg.

The recommended retail price of the EHT Bass Machine is $1699. For further information or the location of a dealer who can arrange a demo, contact **Etone P/L, 6-12 Stanley St, Peakhurst 2210 NSW. (02)534 3569.**

To achieve the right coverage, a number of high frequency horns may be needed angled to cover the area from front to rear. It requires careful choice of driver characteristics, but particularly good results can be achieved. Consider the total coverage angle in the vertical plane, then look to the directivity of the drivers to be used and angle them so that their dispersion angles provide coverage over the previously determined angle. Equalisation, as with any PA system for music, is essential – but that's a whole field on its own!

Where split stacks are used, placed either side of the stage – the "traditional" approach – the stacks need to the angled carefully to provide the required coverage. And this is dependent on the size of the room and the dispersion characteristics of the speakers.

With small rooms, loudspeakers with wide dispersion are required, typically 100 to 130 degrees horizontally and around 90 degrees vertically. A "constant directivity" system is recommended. The centre line of each should be aimed either to cross before reaching the rear wall or to meet at the centre of the rear wall. The stack should be mounted with ▷

A.E.S. ELECTRONICS

76 King Street, Warilla, N.S.W.

(042) 95-1810

AUSTRALIAN MADE P.A. SPEAKERS & AMPLIFIERS

Speakers Feature:

• Etone Drivers • Craftwood construction • Large recessed handles • Steel mesh grills • Large moulded corners • Heavy duty carpet • Very compact • All hand made • Prices start at $790 per pair (300mm driver and 50W horn power rating, 100 watts) • All types of cabinets made to your requirements. (Bass guitar, etc.)

SPECIAL PACKAGE DEAL

P.A. SYSTEM:	8 Channel Phonic Desk	$1200
	A pair of MOD 150H speakers	$995
	Mosfet power amp MOD 300 ms	$750
	Normal price	$2945
	SAVE $445 Special price	$2500

WE ALSO MANUFACTURE A RANGE OF MOSFET POWER AMPLIFIERS

WE SHIP ANYWHERE IN AUSTRALIA.

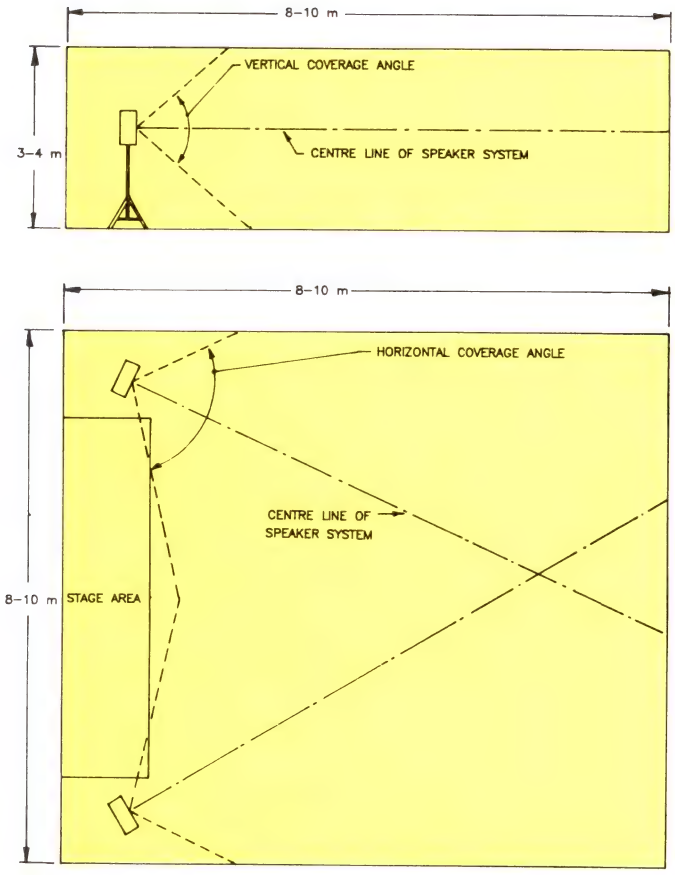


Figure 6. Setting up for a small room. Wide dispersion speaker systems are required.

their centre lines above head height with the audience seated, about 1.5 – 2 m, and aimed horizontally. Figure 6 illustrates. If the audience seating rises from front to rear, mount the stacks so that their centre lines, in elevation, are located midway up the rise, or otherwise "fly" them above the stage and aim the stacks' centre lines at the midway line of the rise.

In medium rooms, similar principles are followed. However, wide dispersion loudspeakers you will find may not provide the required "throw", resulting in poor sound at the rear. Here, narrower dispersion, higher efficiency systems are employed with directivity angles typically half that of systems suited to small rooms. Again, in plan view, the centre lines of the stacks should be aimed at the centre of the rear wall and the high frequency horn mounted above head height. The reduced level up-close, resulting from the narrower dispersion, is compensated by the higher levels necessary in larger venues. See Figure 7.

In really large rooms (no longer a "room"!), the situation prevailing in medium rooms is exaggerated. A combination of short throw/wide dispersion and long throw/narrow dispersion speakers are necessary to provide the coverage. In plan view, aim the stacks' centre lines at the rear wall. The short throw speaker should be mounted atop the stack and aimed down, so that its centre line falls on the floor about half way down the hall. The long throw horns should be mounted so that their centre lines are horizontal and above head height. Figure 8 gives you the idea.

As always, a little experimentation and lots of "checking it out" goes a long way towards achieving the desired result.

We'd like to thank Electro-Voice Pty Ltd for permission to use material from the EV " PA Bible " series of papers

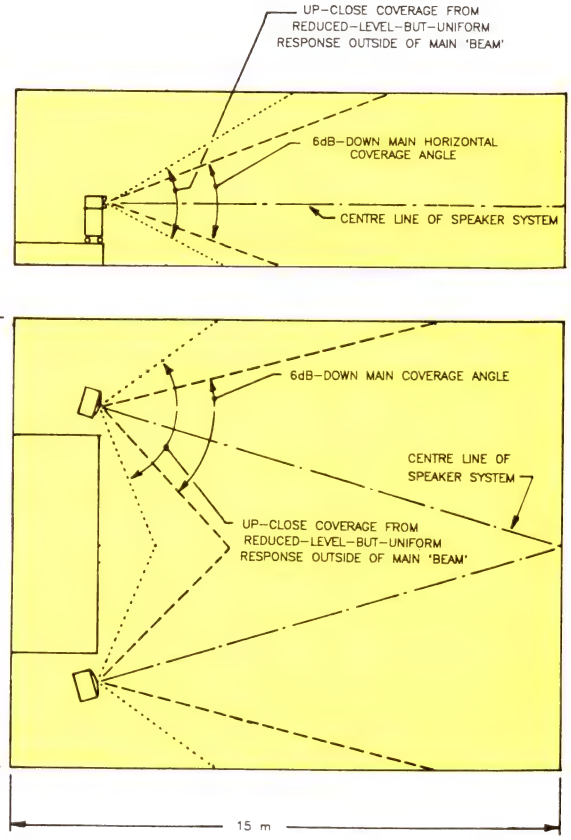

UP–CLOSE COVERAGE FROM REDUCED–LEVEL–BUT–UNIFORM RESPONSE OUTSIDE OF MAIN 'BEAM'
6dB–DOWN MAIN HORIZONTAL COVERAGE ANGLE
CENTRE LINE OF SPEAKER SYSTEM
6dB–DOWN MAIN COVERAGE ANGLE
CENTRE LINE OF SPEAKER SYSTEM
UP–CLOSE COVERAGE FROM REDUCED–LEVEL–BUT–UNIFORM RESPONSE OUTSIDE OF MAIN 'BEAM'
10 m
15 m

Figure 7. Medium size room setup.

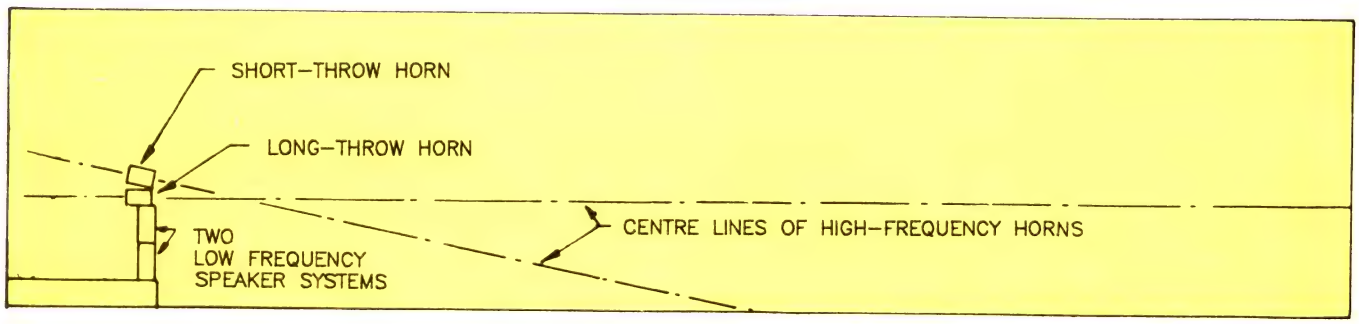
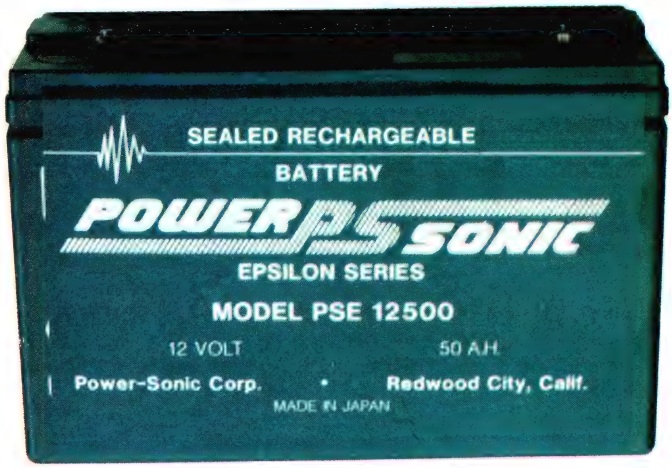


Figure 8. In a large room, short throw and long throw horns with wide and narrow dispersion respectively are required.

STANDBY POWER

We have a large range of sealed lead-acid rechargeable batteries available from stock, ideal for use in uninterruptible power supplies, telecommunications backup, security systems, etc.



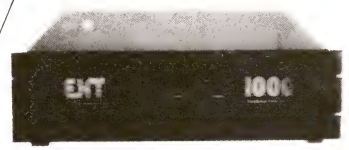
2 V, 150 – 1000 Ampere/Hour

6 V, 0.5 – 130 Ampere/Hour

12 V, 0.7 – 80 Ampere/Hour

POWER-SONIC AUSTRALIA P/L, 13 Watson Rd, PADSTOW 2211 NSW
Phone: (02)772 4522 Fax: (02)772 4863

THE ONLY PROFESSIONAL POWER AMPLIFIER TO BE APPROVED BY OZFI — THE AUSTRALIAN HI-FI MANUFACTURERS GUILD



ELECTRON HANDLING TECHNOLOGIES

SECOND GENERATION MOS-FET PROFESSIONAL POWER AMPLIFIERS

ELECTRON HANDLING TECHNOLOGIES

EHT-2000 : OVER 1000 WATTS RMS/CHANNEL — BOTH CHANNELS DRIVEN
EHT-1000 : OVER 500 WATTS RMS/CHANNEL — BOTH CHANNELS DRIVEN

Just 3 rack units high — super strong, ultra light all alloy chassis — EHT-2000 weighs only 24 Kg — Toroidal Transformers — fully independent power supplies — fully protected against shorted outputs and thermal over-load — power-up anti-surge circuitry eliminates excessive current drain at switch-on — switch-on thump suppression — transformerless balanced inputs protected against excessive input voltage and R.F. interference — fully complementary/balanced and thermally stabilised Octa-differential driver network — Bipolar clipping indicators — plus many more features too numerous to mention.

N.S.W.: Sound On Stage (02) 264 9817; Total Concept Productions (02) 681 5880; Northside Sound (042) 26 1011.
A.C.T.: Pro Audio Supplies (062) 49 7766.
QLD.: Pro Music (07) 369 8144; Paradise Music Factory (075) 55 3494; Island Agencies (070) 31 1717.
VIC.: Pro Music (03) 300 2055. **S.A.**: Musitronics (08) 297 8932. **W.A.**: Marketec (09) 242 1119. **TAS.**: Tasfi (004) 25 5224.

MANUFACTURED IN AUSTRALIA BY:
ETONE PTY. LTD. 6-12 STANLEY STREET, PEAKHURST, N.S.W. 2210 • PHONE: (02) 534 3569, 534 1353

Exhaustive range of P.A. system

Sydney-based importer/distributor, Arista, carries a complete range of PA equipment and accessories, starting at small hand-held megaphones right up to high power units capable of driving many speakers.

PUBLIC ADDRESS SYSTEMS can be set up in an almost infinite variety of configurations to suit the many applications and budgets of the individuals or organisations using them. Correct installation of a system is not difficult if a few basic rules are followed, but many systems have nevertheless provided disappointing results in terms of sound quality or volume because of simple mismatching of the individual components.

With the range of equipment and accessories offered by Arista, the task of building a PA system to provide good quality sound in a wide variety of situations is greatly simplified.

AMPLIFIERS

The workhorse of the PA system is the amplifier itself, and will usually be the most expensive single item in an installation. Amps can be categorised in terms of output power, or more importantly, power source, as the latter often determines the suitability of the amp to the application. The three alternatives are dry cell or battery power, 12 V car battery or ac mains power. Some units offer a combination of ac or dc operation.

Arista's **GT5** is a completely self-contained portable system of the type made popular by salespeople in department stores. It consists of a box about the size of a large bookshelf speaker with an inbuilt amp, speaker, and level controls and is powered by six "D" size cells. Input can be from a microphone or line level device, and the amp features a variable echo to complement budding singers. Power output is only 1 – 2 watts, which is adequate for busking or promotional work.

The **PAE12** is a compact 12 watt amplifier designed for installation in a car, truck or boat. The unit is powered by 12 Vdc, and can be used with an optional mains dc power supply if required. Foghorn and siren sound effects are included as standard, so discretion would have to be exercised with use of the amp in public areas. The amp is about the size of a car radio, and includes an under-dash mounting bracket.

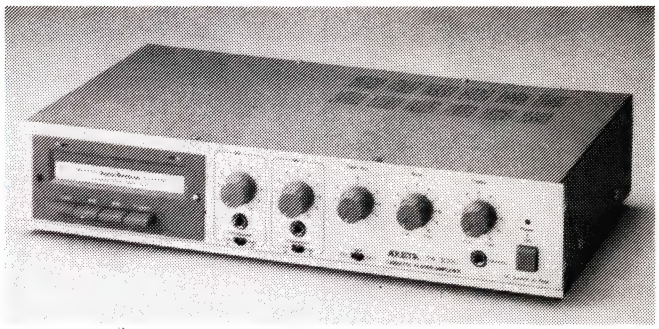
The **PAE-15** is similar to the PAE-12, and includes an in-built ac power supply which makes it a little higher and about twice as heavy. Output power is 15 watts, and a chime sound effect is included. This amp would be very handy where emergency dc power is required, but ac is expected to be used routinely, for example in a small school hall.

Both of the above amplifiers are primarily intended for mobile use, or portable use supported by a vehicle's battery. In their standard form they are suited to driving only one or two speakers, as the output is at 8 Ohms, rather than the high impedance line level required for multiple speaker set-ups.

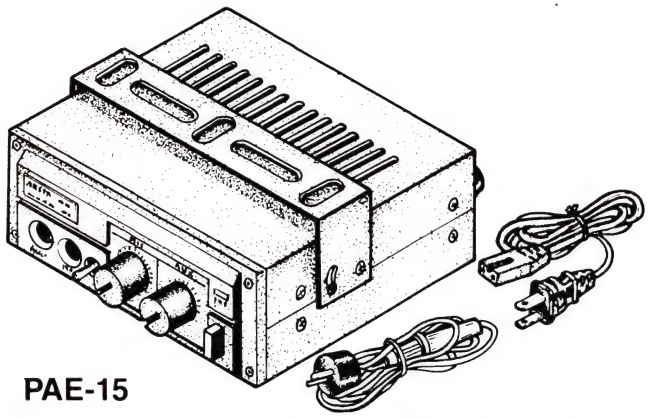
The **TPA** range of amplifiers comprises five units with output power ranging from 20 – 50 watts. All but the 50 watt model are dual ac/dc power, all offer low impedance outputs for single speakers and high impedance outputs for multiple connections. Separate controls are provided for two microphones, two auxiliary inputs, and bass and treble adjustment. Microphone input 1 is voice-activated, and works as a priority pager, over-riding other inputs.

The TPA range would be ideal for use where battery backup is needed. Their size (270 x 225 x 88 mm) all but precludes their use in a vehicle, which is plainly not their intended application.

Arista's high-power amps are the **TPA60 and TPA120,** named for their output power in watts. Both models require ac power and supply both low and high impedance outputs. Controls include level for five independent microphones, one additional selectable for turntable input and two auxiliary inputs. Separate bass and treble controls, and a master volume control are provided.



PA300C



PAE-15

The TPA60/120 series are intended for medium scale installations in fixed locations, such as church or school halls, factories, shops etc. Emergency operation should not be required, as dc operation is not supported.

The **BA120** is a 120 watt RMS booster, or power amplifier with line level input. Output specifications are similar to the TPA120, but a separate mixer/preamplifier must be used for input. This makes the BA120 well suited to theatrical groups or small bands where more sophisticated mixing facilities than the TPAs provide are required. Controls are simply on/off and master level, and an output level meter is included.

LOUDSPEAKERS

Speakers for PA systems come in three basic categories: weatherproof horns for outdoor use, indoor high- power systems and ceiling-mounted low-power units.

Arista carries a wide range of weatherproof horn speakers. The **SPH1 & 2** are compact horns rated at 8 and 10 watts respectively, and are primarily intended for outdoors use where only limited coverage is required.

The **SPH4, 6, 8 and SPH615** are 15 watt horns well suited to small – medium outdoor installations. The SPH4 and 6 have an 8 Ohm input, and the SPH8 features a multi-tapped "100 V line" transformer input for multiple speaker set-ups.

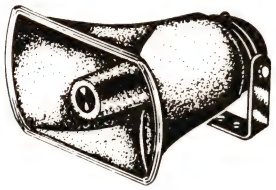
The **SPH12** is a 317 mm (12") weatherproof aluminium horn with a 25 watt rating and in-built line transformer. It makes a good, general "workhorse" horn for outdoors use.

The **SPH16** is a top-line heavy duty weatherproof horn 400 mm (16") in diameter. Replacement drivers are available for the speaker with either 15 or 30 watt ratings. The availability of these spare parts suggests an attitude to longevity which should be a comfort to the intending purchaser.

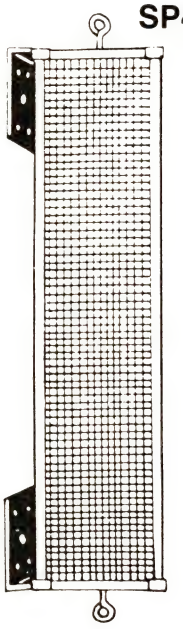
None of the above horn speakers are intended to provide high fidelity sound reproduction. They are designed to be power-efficient, providing the maximum volume level for a given input power. They are best used for amplification of speech, whilst still being suitable

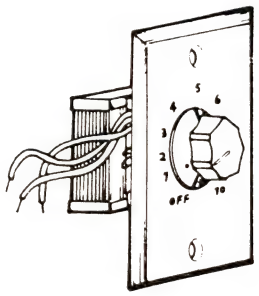
components

SPH4



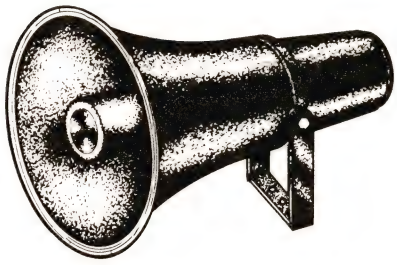
SP45LT.

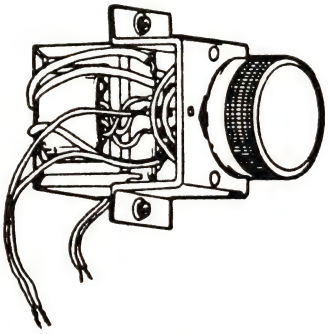




LMT7A

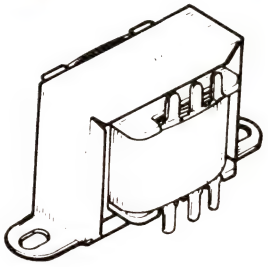
SPH 8



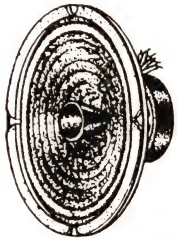


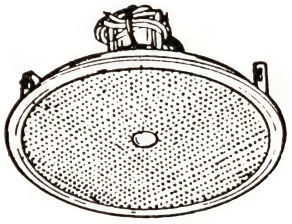
LMT3

LMT 4



SP85LT





SP83G

for background music. Professional musicians would not usually consider these speakers, as the frequency response drops off around 5 – 7 kHz.

Indoor PA systems would more typically use a column speaker, such as the Arista **SP45LT.** Ruggedly constructed from extruded aluminium with a steel mesh grille. The SP45LT uses four 125 mm (5") speakers, and provides a frequency response more akin to a hi-fi application than PA. Power handling capability is 20 watts, and a typical installation would use two, or even four of the units. A line transformer is included as standard. The sound quality from these column speakers is far better than from horn speakers, but they cannot of course be mounted permanently outside.

Arista stock two extension speakers, the **SP1 and 2.** These speakers can be used for piping announcements into separate rooms, or for monitoring the sound level and quality on-stage. The SP1 has an 8 Ohm input and is fitted with a volume control. Power rating is five watts maximum. The SP2 has a built-in line transformer and a six-position attenuator switch in place of a continuous volume control. Both speakers are mounted in walnut cabinets, and are intended for low-volume use, such as in dressing rooms, classrooms, offices or on-stage. They are not intended to be the primary output for a system, except perhaps in distributed low-volume applications such as offices.

The **SP83LT and SP85LT** are speakers intended for existing or build-your-own PA speakers. They are both 200 mm (8") diameter, and include line matching transformers. Frequency response is quoted at 80 Hz to 18 kHz, and power ratings are 3 W and 6 W respectively.

Another method for distributing PA systems over a large indoor area is with ceiling mounted speakers. The **SP83G** is a 200 mm ceiling mount speaker rated at three watts, and the **SP55G** is a 130 mm model with a rated power capacity of 10 watts. Both speakers are simple to mount flush with the ceiling, and include line transformers for 100 V line installation as well as metal grilles.

The **SPG1 – 4** components are ceiling speaker grilles well suited to the do-it-yourselfer. They range in size from 100 mm (4") up to 200 mm (8").

ACCESSORIES

There are multitudes of accessories applicable to PA systems, from hook-up wire to mounting brackets. The items most significant to high quality efficient operation are impedance matching transformers and volume controls.

Some PA speakers come standard with a 4 or 8 Ohm input, which can be quite satisfactorily used in one or two speaker set-ups provided that the amplifier has a matching low impedance output. If, however, the amp has a line output (70 or 100 V, high impedance), or if a larger number of speakers is required, then a speaker line transformer must be fitted to the speaker input. Where long cable runs are required, it is essential that the speaker system be fed from a 70 V or 100 V high impedance line for maximum efficiency and to maintain volume levels throughout the system. This requires each speaker in the system to be fed from a transformer.

Arista's **LMT1, 2 and 4** are 5, 10 and 20 watt line transformers intended to be mounted on, or very close to the PA speaker. A large number of speakers equipped with these transformers may be connected in parallel to an amplifier's output. Each transformer features multi-taps, which enable the selection of appropriate volume levels or power capacities.

The **LMT3** is a six-position speaker transformer switch which allows the instant selection of local volume or power levels through the above line transformers.

Volume can also be adjusted with either the **LMT7A** or the **LMT8A** 100 V line volume controls. They are both wall-mounted and feature 11-position switches. Ultimate volume or power levels can be selected at installation with either full, ½ or ¼ power input options.

The **LMT10, 11 and 12** are matching transformers rated at 20, 35 and 50 watts respectively. They are designed to provide a high impedance line output from amplifiers which are not normally equipped to do so. This enables home hi-fi amplifiers, for example, to be used as multi-speaker PA amps.

For further information on the Arista range of PA equipment, components and accessories, or to get a copy of their catalogue, contact **Arista Electronics, 57 Vore St, Silverwater 2141 NSW. (02) 648 3488.**

Some light on the charge brigade

Jeff Ralph

Last month we discussed primary and secondary cells in some detail, and now is the time to get down to the nitty-gritty of recharging. After all, those secondary cells and batteries wouldn't be much use if we couldn't revitalise them, would they?

SECONDARY CELLS, sometimes referred to as storage cells, accumulators or just plain rechargeable batteries, are those which employ a *reversible* chemical reaction. The application of a load to the cell will drain, or discharge the cell, and the application of external current will replenish, or recharge the cell.

Recharging, and the correct way to accomplish it, is the process which we are concerned with here.

The two common types of secondary cells are the lead/acid wet cell, as is used universally in vehicle electrical systems, and the nickel/cadmium, or NiCad cell, as is being used in ever-increasing numbers in various small portable devices. The two types share *some* common features, but there are many more differences than similarities. We will deal with them separately.

Lead/Acid batteries.

The most widely-used source of stored, rechargeable energy today is unquestionably the lead/acid secondary cell, in the form of the common car battery.

Next time you're driving in heavy traffic, spare a brief thought for the multitudes of battery-charging operations going on all around you – one under every bonnet! Thankfully for the average motorist, the charge/discharge cycle in the car battery is well controlled and regulated, and typically will not require attention, other than routine checks of electrolyte level, for upwards of years on end.

Modern alternator and regulator systems are capable of maintaining a charge in the battery under all but the most severe conditions. If you're driving slowly on a wet night, with high beam, wipers, rear-screen demister and radio all turned on, then your poor old battery will have to give more than it gets, but under most circumstances the battery will be kept topped up with close to a full charge.

There are two practical ways of determining the state of charge of your car battery: by measuring the electrolyte's specific gravity, or by measuring the voltage of the battery.

Specific gravity is a measure of the density of a liquid in comparison to distilled water, which yields an SG reading of 1.000. As a lead/acid cell is charged, sulphate ions leave the lead plates and go into solution in the electrolyte, increasing its acidity and hence its specific gravity. Therefore, the higher the SG, the greater the level of charge.

Lead/acid batteries are made in many different types and sizes, as shown by the 6 V, 0.5 Ah example here. It is a sealed type, made by PowerSonic, and it measures just 57 x 50 x 14 mm.

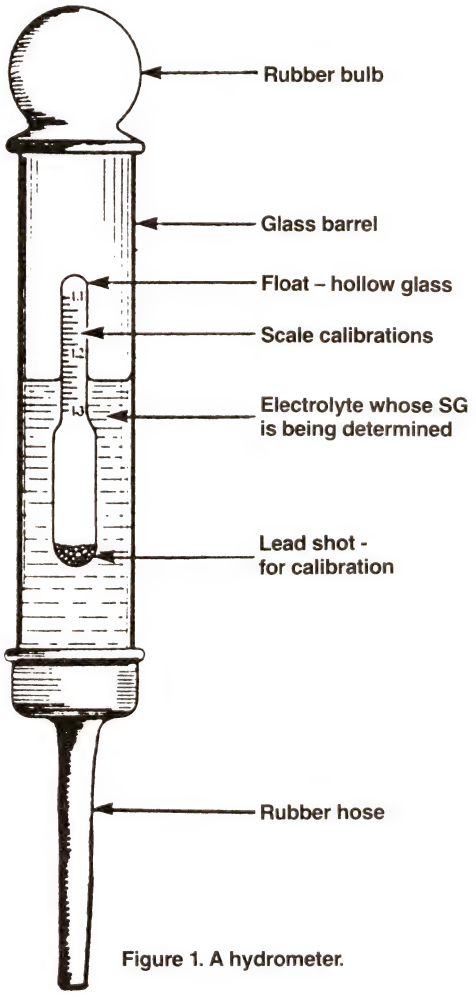


Figure 1. A hydrometer.

A fully charged car battery will yield an SG somewhere between 1.260 – 1.275. A reading of 1.180 indicates a practically dead flat battery. To use a hydrometer, simply insert the nozzle through the vent and draw electrolyte solution into the body of the instrument, using the rubber bulb. Making sure that the float inside the glass barrel is floating freely, simply read the SG from the calibrations on the float.

If all is well, the SG in all six cells will be identical, or at least very close during all of the charging cycle. If any one cell displays an atypically low SG, it is probably an indication of contamination or partial internal short circuit from residues. Unless a battery has been abused by persistent overcharging or deep discharging, this should not be apparent until a battery has reached the end of a long life.

Another method of determining state of charge of a lead/acid battery is by reading the voltage under varying conditions. This method is certainly more convenient than reading specific gravity, as suitable voltmeters for dashboard mount-

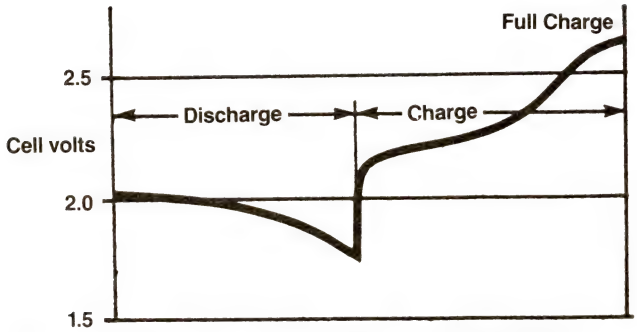


Figure 2. Typical voltage characteristics of a lead/acid cell.

ing, but interpretation of the results is not quite so straightforward.

The nominal lead/acid cell voltage is reckoned to be 2 V, so six cells yield the familiar 12 V. A freshly charged battery will yield 13.5 – 14 V unloaded, and a battery low on charge will measure around 11.5 – 12 V unloaded. These figures will be reduced by the application of a load.

Recharging of car batteries is, as mentioned earlier, usually accomplished automatically by the car's own system. If, however, driving conditions have been consistently poor, or if the battery is being used in another application – to provide "standby" power for some equipment, for example – then charging will have to be provided from an external source.

The basic requirement for a charger is that it be able to supply an emf greater than the battery voltage, at the required current.

The recommended initial charging current for a lead/acid battery is 0.2 A per amp/hour of the battery's capacity. Therefore a 40 Ah battery (a common capacity) would require an initial charging current of 8 A for an 'optimum' charging rate.

The charging current is effectively limited by the temperature reached by the electrolyte, which should not exceed 38° C.

As the battery charges, its cell voltage rises gradually from the nominal 2 V until the point where the generation of gases begins, at around 2.3 V per cell, (13.8 V for the battery). At this stage the charge current should be reduced to around one quarter of the initial rate, or 2 A for the example above. Charging should then continue until the cells measure 2.6 V (15.6 V total), or the specific gravity reaches 1.275.

The charging currents calculated above are for the *optimum* charging rate, and won't be achieved by most small chargers in use in the garage at home. These devices typically provide around 4 A for for the first few minutes of charging, and rapidly drop to around half of that value. With such chargers, a complete recharge can take longer than a full day.

Lead/acid batteries may be trickle-charged. That is; left on charge permanently, with currents in the range of only one to three milliamps per Ah capacity. Thus, a 40 Ah battery would require between 40 and 120 mA to maintain a continual "float" charge.

No attempt should be made to use lead/acid batteries once they have become discharged, and they must not be left stored in the discharged condition. Under these circumstances, the battery may become **deep discharged,** with a consequent ruinous loss in capacity. This effect is caused by the crystallisation of excess lead sulphide on the plates of the cells, yielding a difficult- to-remove deposit which, among other things, reduces the effective surface area of the plates.

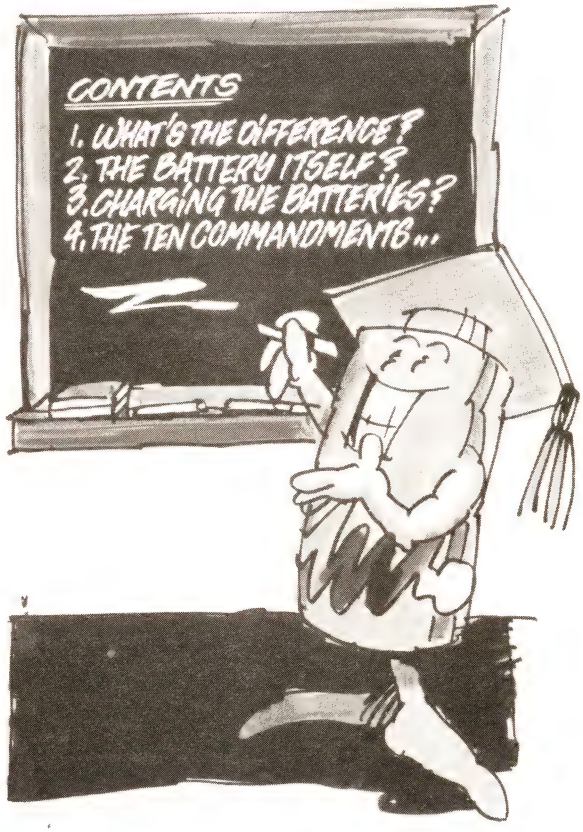
A deep discharged battery can be rejuvenated to a certain extent by overcharging it by a factor of about 1.5, but some permanent loss of capacity is to be expected, depending on the severity of the deep discharging. A little more capacity will be regained with the next few discharge/charge cycles, but never back to 100%.

During charging, a large quantity of hydrogen gas is generated, and, being potentially highly explosive, must be allowed to disperse through the provision of good ventilation. When charging a car battery, the positive terminal connection to the car's system should be disconnected, to prevent possible damage to the car's components caused by the charger's consistently higher-than- usual voltage. Don't forget to reset your dashboard clock!

NiCad cells and batteries

Rechargeable dry cells of the nickel cadmium, or NiCad variety, are capable of up to 1000 charge/discharge cycles *if treated correctly.* There are a number of reasons why some NiCads don't achieve this potential, but the most common causes include overcharging and overdischarging.

Unfortunately, there is a fairly delicate balance between the right and wrong levels of discharging and charging. If a NiCad is overcharged it will overheat and generate gases ▷



RECHARGEABLE BATTERIES – ANSWERS TO THE MOST ASKED QUESTIONS

Late last year, Arlec released a small, pocket-sized 24-page booklet with the above title. "Nikki NiCad", an animated Arlec rechargeable battery, takes the reader through the four main sections of the booklet.

"What's the Difference?" comes first, wherein rechargeable batteries are compared to common alkaline and carbon/zinc types in a simple, easy to read manner.

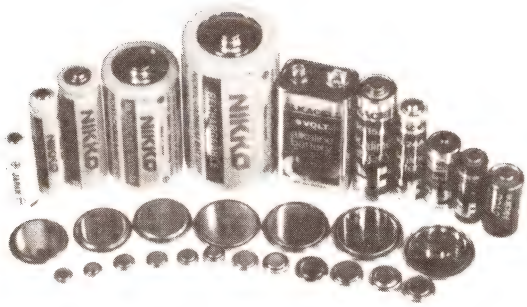
Nikki and "friends" explain how NiCads are made in section two, titled "The Battery Itself", and point out the various features of these rechargeables.

"Charging the Battery" is the next section, which examines the simple process of 'restoring life' to a rechargeable battery.

Section four outlines "The Ten Commandments" – the golden DOs and DON'Ts with rechargeables.

The booklet is written in a bright, largely non-technical, but informative style, and attempts to strike a balance between animation and information.

If you'd like a copy, ask at your nearest Arlec outlet, or contact Arlec directly, at 30-32 Lexton Rd, (PO Box 170) Box Hill 3128 Vic. (03)895 0222.



The Nikko range of NiCad cells, distributed by Arista, is here displayed with the accompanying range of alkaline button cells and batteries.

which can, in extreme cases, cause the rupture of the cell, or more likely cause venting and loss of active materials. At the other end of the scale, if a NiCad is allowed to run down past the point where it is considered "flat", there is a chance that its voltage will drop all the way to zero, at which point it can be driven into reverse polarity by the remaining cells. Both of these extremes will cause loss of capacity and shortening of the life of a NiCad cell.

It doesn't pay to be too cautious, however. A NiCad should be allowed to discharge **fully** before recharging, otherwise it will display the property of "memory". Simply stated, this means the cell will "remember" the level at which it ceased discharging, or providing power, and will tend to call it quits in future at *that* level. This loss of capacity through memory can be remedied through a number of complete charge/discharge cycles, but repeated partial discharges can result in permanent loss.

So, the rule is: discharge the cells completely, but don't overdo it. Recharge them fully as well, but likewise don't overdo it.

How do you know when NiCads are discharged? Fortunately this is not difficult. Unlike conventional non-rechargeable dry cells, NiCads exhibit a very constant cell voltage during use. A regular dry cell begins life at a nominal 1.5 V, which gradually drops to whatever the "flat" voltage for the device in use may be – from around 1.1 V to as low as 0.6 V. When a NiCad goes into service it produces a little more than 1.2 V, and this remains very stable until the cell is exhausted, at which point the "knee" of the voltage curve is reached, and the cell voltage drops rapidly.

Therefore, when a NiCad cell starts to drop in voltage it is completely (effectively) discharged, and should not be used again until it is recharged. This also means that, unlike a lead/acid cell, terminal voltage will *usually* not give an indication of state of charge – only at the end of the discharge cycle is this measurement valid.

So, in summary, when your NiCad-powered device **starts** to show the signs of reduced cell voltage, stop using it immediately.

Incidentally, no harm is done to NiCads if they are **stored** in the discharged state – they are nearly always sold that way – the danger comes from allowing other cells to reverse-polarise them through running them too flat. NiCads must not be short-circuited, either. Their low internal resistance allows them to supply very large currents for short periods, and this can severely damage the cell through overheating and gassing. For this reason, NiCads should never be short-circuited – they may explode!

Charging current is, like lead/acid cells, a function of the cell's capacity. The figures given in Table 1 show the average capacity in mAh (known as "C" when expressed in mA) for common NiCad sizes, and the appropriate charging currents for normal and trickle charging.

As you can see, the recommended charging rate can be expressed as 1.4 x the 10 hr discharge rate, or, 1/10 the capacity rate for 14 hours (some manufacturers recommend 15 hours).

The trickle charge rate can be maintained indefinitely without damaging the cell or losing capacity. A fully discharged cell will take a few days to fully charge on trickle, but there is no risk of overcharging.

The 14-hour rate is the optimum compromise between speed of recharge and longevity. If you can afford the time, this is the rate which will be most likely to allow your cells to reach the magic 1000 charge/discharge cycles.

Size	Capacity (mAh)	14 hour rate (mA)	trickle rate (mA)
AAA	180	18	3.6–6
AA	500	50	10–17
C	1200	120	24–40
D	1200	120	24–40
9V	80	8	1.6–2.7

TABLE 1. Capacities and charging rates for NiCads

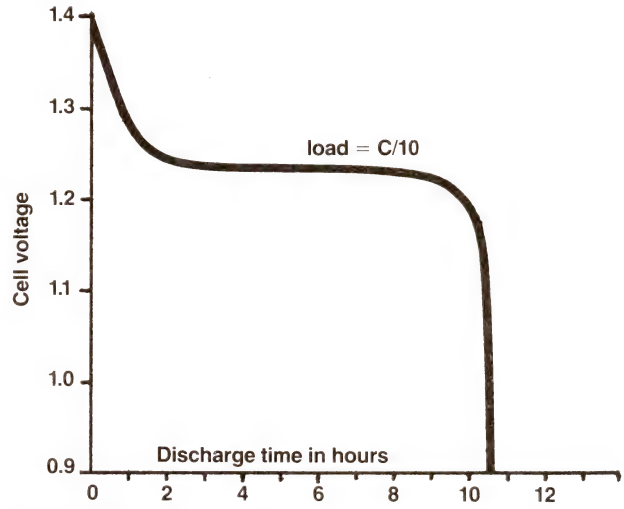


Figure 3. Typical voltage characteristics of NiCad cell.

Considerably faster rates are possible, and in some cases just about necessary, but they inevitably reduce the ultimate capacity of the cells. In the case of radio- controlled cars, for example, drain is high and a set of fully charged cells may be exhausted in less than half an hour. Under these circumstances, some sort of "fast-charger" is desirable, and the loss of capacity is a small price to pay for the convenience of fast charging. NiCads used this way are still much more economical than the equivalent non-rechargeable dry cells.

In December 1986 we published a design for such a fast-charger, and it supplied between two and five amps to the six-cell battery pack. This translates to more than 20 times the recommended 14-hour rate, so this charger included a very necessary feature – a timer cut-off. Thus the charger was disabled before the cells had any chance of becoming damaged through overheating.

The above fast-charger cut off after a set time. Other ways of automatically preventing overcharging are by detecting cell temperature or voltage. The vast majority of chargers don't cut off automatically, however, so you must be vigilant.

If you are making your own charger (see AEM, April '88), then determine the current carefully, and maintain the correct time religiously. If using a commercial unit, then follow the manufacturer's directions carefully. Giving the cells "an extra little bit of juice" *won't* make them last any longer. The manufacturers claim that the 14-hour rate can be maintained up to 24 hours without permanent damage, but the cumulative effect of this overcharging is certain to lower the ultimate capacity of your cells.

Remember, trickle charging is again the safe option if you are prone to forgetting to switch off.

Elektor Electronics in AEM

CONTENTS

PROJECTS

Build a Plotter 34

VLF Converter 42

ARTICLES

Multi-standard Colour Decoder IC 45

Copper on Ceramic Micro-Electronic Technology 48

Breakthrough in Superconducting Materials 49

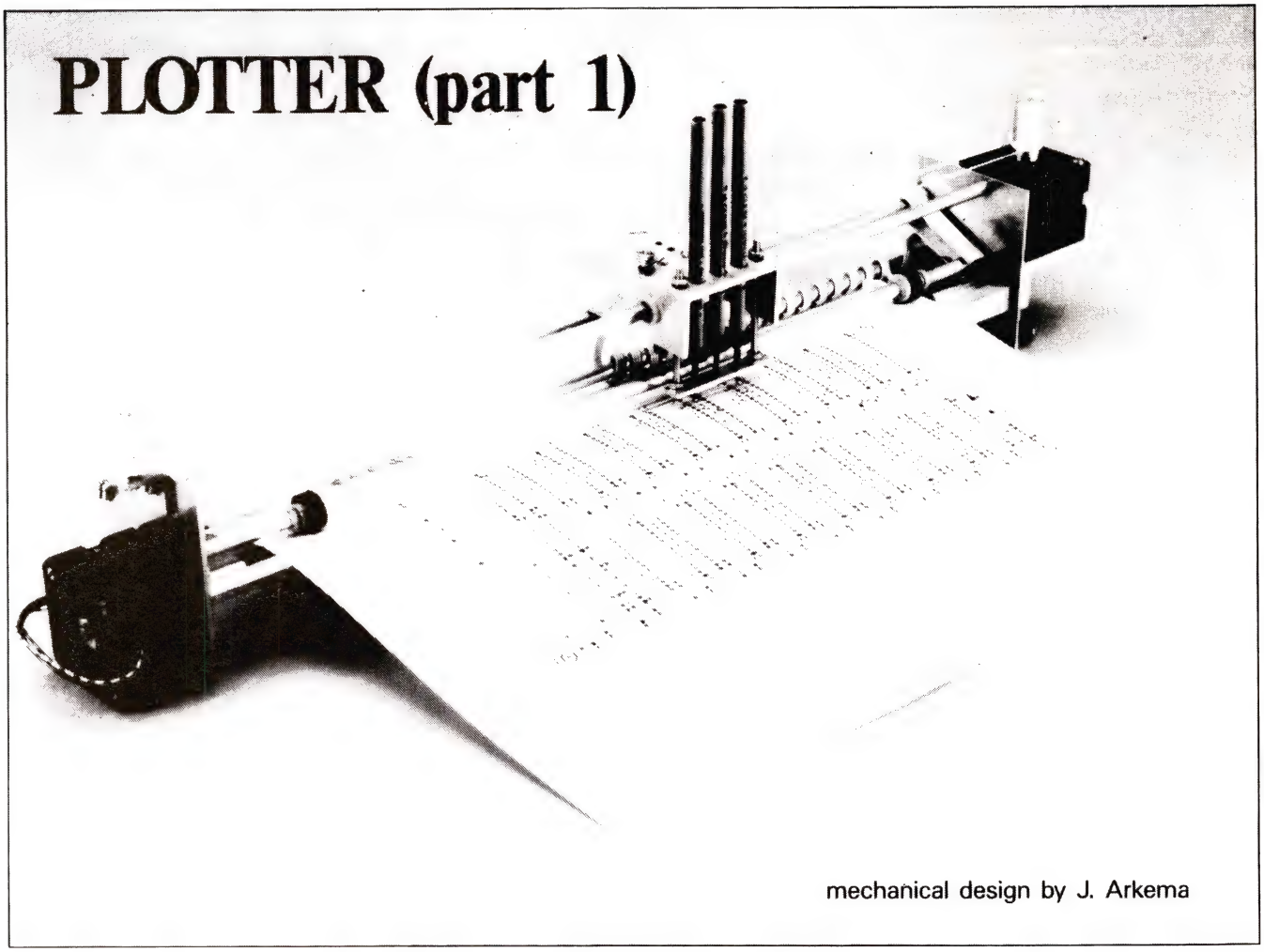
The projects and circuits chosen for inclusion in the Elektor section are selected on the basis of interest, local relevance and component availability. Intending constructors should consult our 'PROJECT BUYERS GUIDE' in this issue for a guide to component sources and possible kit suppliers.

The contents of this section are copyright,

© Uitgeversmaatschappij Elektuur B. V. (Beek, the Netherlands) 1986.

Any infringement of this copyright will be prosecuted to the full extent, including unauthorised manufacture of pc boards intended for re-sale.

PLOTTER (part 1)



mechanical design by J. Arkema

Many owners of a personal computer and associated peripheral equipment will at some time have wished that graphics information available on screen could be sent to a plotter instead of a slow, noisy printer operated in the dot-matrix mode. But then, even the simplest of plotters is often more expensive than the computer itself.
Not so the plotter described here, which is a unique project: fairly simple to build, complete with a versatile and power-efficient stepper motor interface driver, available in kit form, and offering a good price/performance ratio. The final accuracy of the plotter should be adequate for a host of graphics applications, and depends mainly on the constructor's mechanical skills.

Matrix printers are fine for text applications, but can not handle graphics information very well. They are invariably slow because in the bit image mode pixels are printed one line at a time. In addition, their resolution is insufficient for many applications, they are noisy, and only very few types can handle large sheets of paper (A2; A3).

The plotter described here is not of the X-Y type commonly found in the least expensive class of commercially available plotters, but is similar to a standard text printer in that it has a pen carriage for the horizontal (X) direction, and a platen (paper roller) for the vertical (Y) direction. This approach makes it possible to keep the mechanical construction relatively simple, while allowing many paper sizes to be used. The platen is driven direct by a stepper motor; the pen carriage indirect by a string and a second stepper motor. Arguably, in the absence of an absolute X-Y reference point, this arrangement has the disadvantage of being subject to accumulative positioning errors. Fortunately, deviations caused by these errors can be kept small in practice by ensuring that the paper and the carriage are not obstructed in their respective movement.
Small electro-magnets are used for lifting and lowering the three pens. These are simply refills available from bookshops and warehouses, and come in various colours for many types of inexpensive drawing pen. The pen carriage on the plotter is shown in the photograph of Fig. 1.

The stepper motor interface board for the plotter can be driven by an 8-bit Centronics port, which is a standard outlet available on the majority of modern computers. Control bits are arranged in a manner to enable direct connection of the Centronics port to the plotter interface board via a length of flat ribbon cable. The control circuit has been designed for efficient powering of the stepper motors and pen magnets. The power supply, exclusive of the mains trans-

former, is accomodated on the interface board to make for a compact and simple to connect unit.

Mechanical construction

The plotter is essentially a beam construction as shown in Figs. 2a and 2b. Two aluminium support plates (60×70×2 mm) at either side hold the complete assembly in between them. The stepper motors are secured to the outside of the plates. Three round bars (dia. 6 mm solid aluminium or stainless steel tubing), and one square bar (10×10 mm aluminium) are fitted between the support plates. The length of the bars determines the maximum paper size, and can be dimensioned to individual requirement. A length of 508 mm, for example, enables sideways drawing on A2 size sheets of paper, often used in the graphics industry.

Details on the construction of all the mechanical parts for building the plotter are shown in the working sheet of Fig. 3. The paper roller is a round aluminium rod (spindle) of 12 mm diameter fitted immediately behind the square bar. Good grip on the paper sheet is ensured by reducing the diameter of the platen a few tenths of a millimeter over two lengths of 30 mm by turning in a lathe, and covering these areas in very fine sandpaper, wound spirally and glued onto the aluminium surface. Every precaution should be taken to prevent the total diameter of the platen increasing where the sandpaper is secured. Two pressure rollers, fitted on a movable axle, rest on the sandpaper grips (see Fig. 4). To insert or remove a sheet of paper, the axle can be lifted by means of two small tilt levers made from aluminium U-beam. The rollers are firmly pressed onto the paper by the pull of two small springs.

The platen is driven direct by a stepper motor with a step size of 200 per revolution. At the indicated platen diameter of 12 mm, this results in a resolution of 0.19 mm/step. Half-step operation is also supported by the driver board, increasing the attainable resolution to slightly less than 0.1 mm.

The pen carriage is in essence a short length of aluminium U-beam. The guide rod runs through nylon slide bearings (Skiffy) secured in holes drilled in the legs of the U. Tilting of the pen carriage is prevented by its rear side resting on another rod. Carriage movement on the guide bar is effected with the aid of a string. This is wound one and a half turn around a shaft, up to the height of the securing screw, and then a further six to ten turns upwards. The shaft is made from the same material as the platen, and is fitted onto the spindle of the stepper motor. For optimum accuracy, the total diameter of the shaft plus string should equal that of the platen (12 mm).

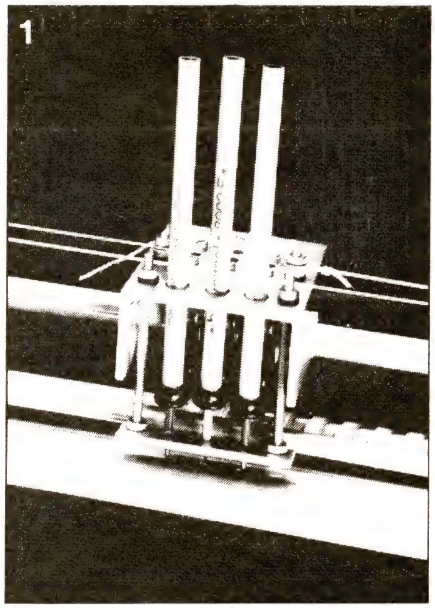


Fig. 1. The movable carriage on the plotter holds three pen refills in different colours. Not visible in the photograph are the associated electromagnets for pen up/down control.

This ensures equal pen travel per step in the X and Y direction. Each pen is guided through a hole drilled in the top of the U-beam, while the tips are kept firmly positioned on or above the paper with the aid of a support plate. The square aluminium bar in front of the

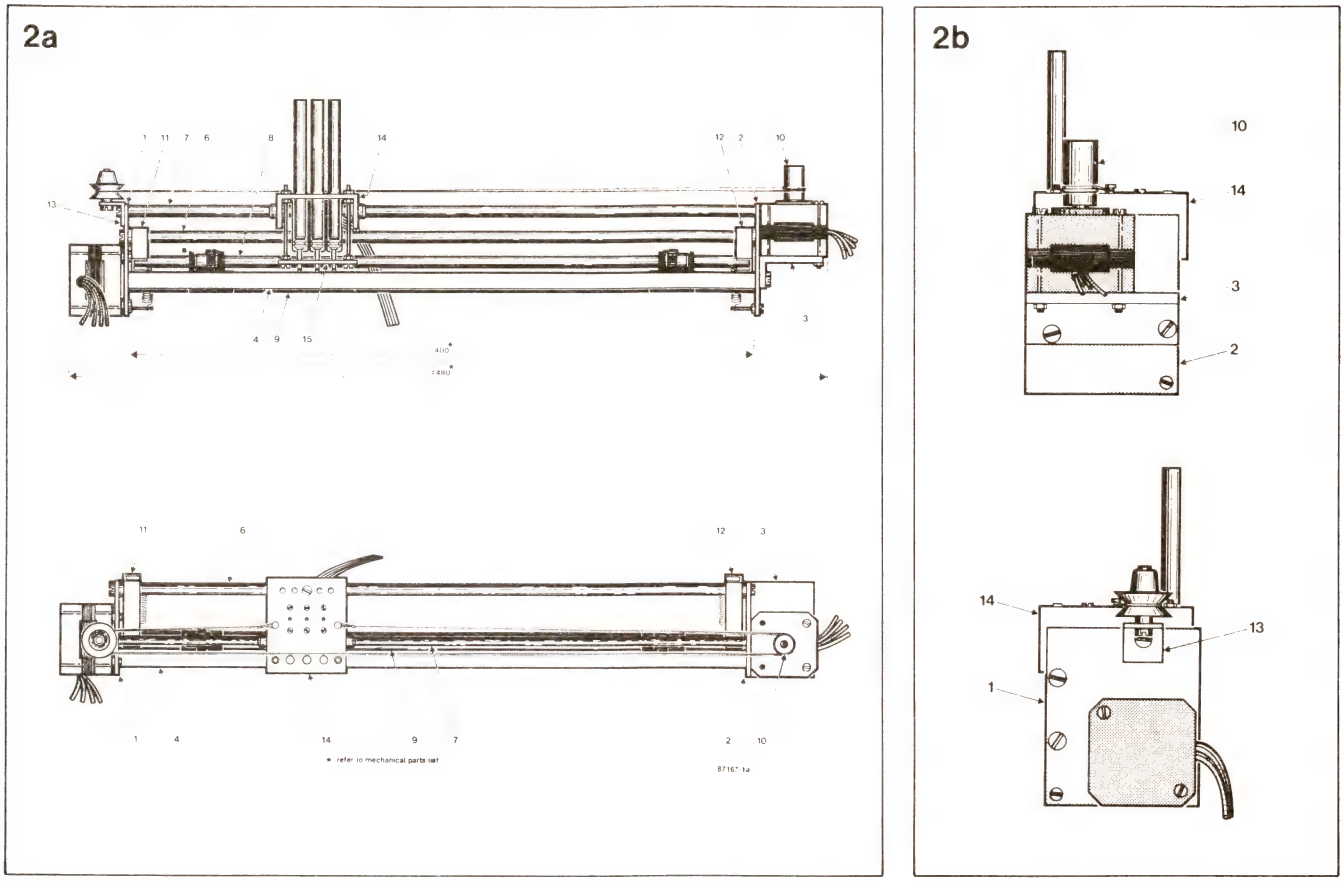


Fig. 2. Working drawings of the assembled plotter seen from the front and top (a) and from the sides (b).

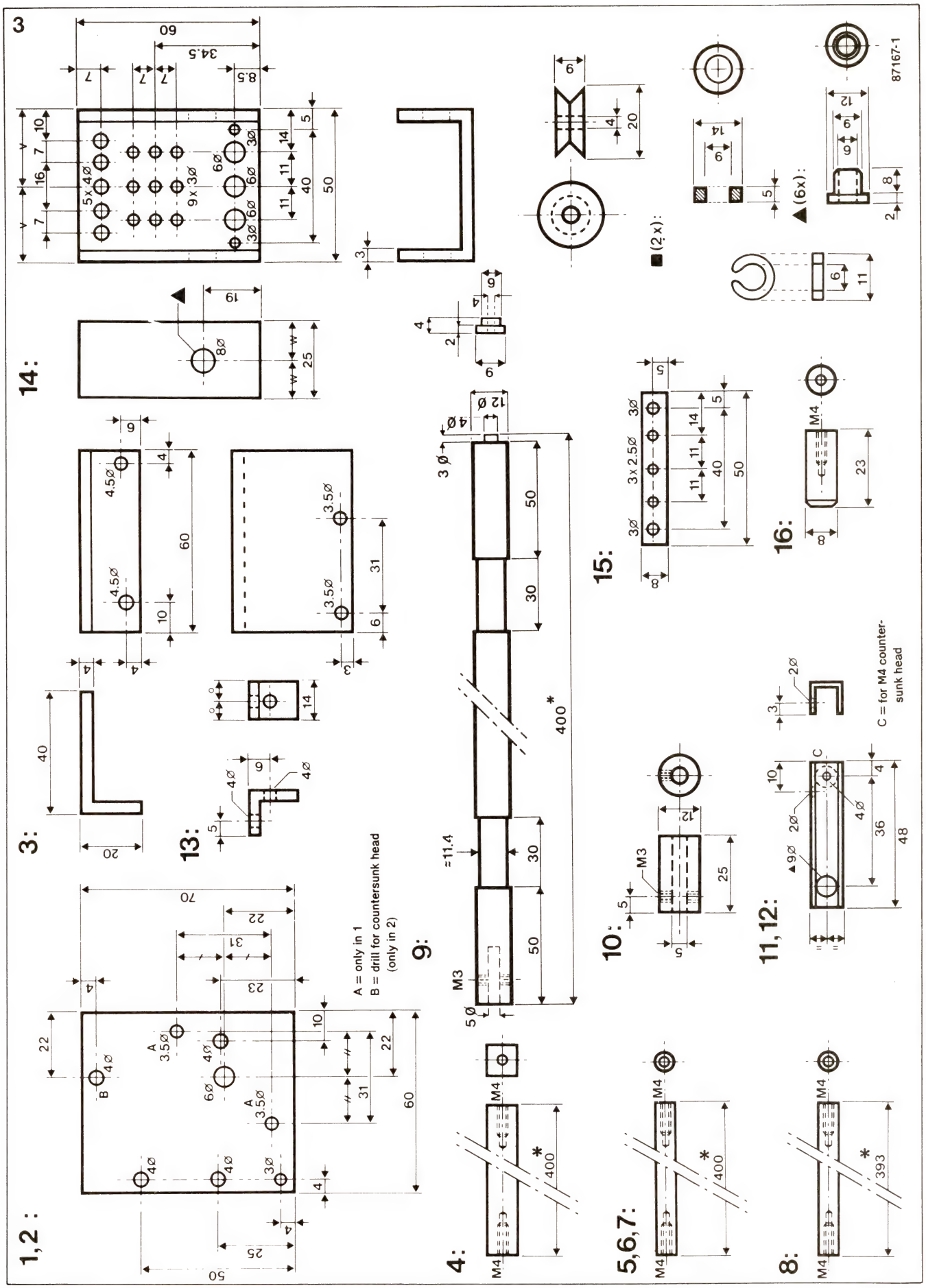


Fig. 3. Dimensions of all nylon and aluminium or stainless steel parts that must be cut, filed, turned and drilled.

Mechanical Parts list

1. side plate; left; aluminium; 60 × 70 × 2 mm.
2. side plate; right; aluminium; 60 × 70 × 2 mm.
3. angled support bracket for X motor; L-shaped aluminium; 20 × 40 × 4 mm; length 60 mm.
4. square connection bar; aluminium 10 × 10 mm; 400 mm long*
5. round connection bar; aluminium/stainless steel rod; dia. 6 mm; 400 mm long*.
6. round support bar for pen carriage; dimensions as 5).
7. round guide bar for pen carriage; dimensions as 5).
8. round bar for pressure rolls; aluminium/stainless steel rod; dia. 6 mm; length 393 mm*.
9. platen; round aluminium bar; dia. 12 mm; length 400 mm*.
10. shaft; aluminium; dia. 11.2 mm (see text); length 25 mm.
11. tilt lever for pressure rolls spindle; U-shaped aluminium beam 10 × 10 × 1 mm; length 48 mm.
12. see 11).
13. angled support bracket for string wheel; U-shaped aluminium beam 15 × 15 × 2 mm; length 15 mm.
14. pen carriage; U-shaped aluminium beam 25 × 50 × 3 mm; length 60 mm.
15. pen positioning plate; aluminium; 8 × 50 × 2 mm.
16. pen carriage support; nylon; dia. 8 mm; length 23 mm.

Miscellaneous parts:

6 off slide bearings; nylon; Skiffy 08-6.
1 off bushing for platen; nylon; Skiffy 08-4 or 08-6.
2 off washer rings; internal dia. 3 mm; thickness 2 mm.
2 off rubber pressure rolls (e.g. cable grommet).
4 off fixing rings for dia. 6 mm spindle (e.g. Skiffy 11-1-6).
1 off string wheel.
3 off cylinder head screws M4 × 5.
2 off cylinder head screws M4 × 10 (for fixing part no. 3).
1 off cylinder head screw M4 × 20 with 3 nuts.
5 off M4 × 5 screws with countersunk head.
4 off cylinder head screws M3 × 40 (for fixing stepper motors).
2 off cylinder head screws M3 × 50 (for fixing part no. 15).
2 off cylinder head screws M3 × 10 (for fixing string).
2 off cylinder head screws M3 × 15 (for fixing spring brackets).
4 off headless adjustment screws M3 × 3 (for fixing part nos. 9 and 10).
6 off bolts M2.6 × 5 (for fixing pen lift magnets).
16 off hexagonal nuts M3.
2 off springs for pressure rolls spindle.
string; wound fishing line; 1100 mm*.
fine grade sandpaper (for securing on platen).

Electromechanical parts:

2 off stepper motors; 200 steps/rev.; dual-phase bipolar; 200 mA/phase (e.g. Berger as used in disk drives).
3 off pen lift electromagnets; 12 V; e.g. Binder Magnete Type 40031-09B00.

* Length in accordance with required size of plotter.
Distributor of Skiffy products in the UK is Salterfix Fasteners • Salter Springs & Pressings Limited • Spring Road • Smethwick • Warley • West Midlands B66 1PF. Telephone: (021 553) 2929. Telex: 337877.

platen functions as a flat surface onto which the paper rests as the lines are drawn on it. An electromagnet to each pen arranges for this to be lifted from the paper when its colour is not required at a particular co-ordinate position on the sheet.

The drawings and photographs in this article, in combination with the mechanical parts list, should give sufficient details on the basic construction of the plotter, which is reverted to below.

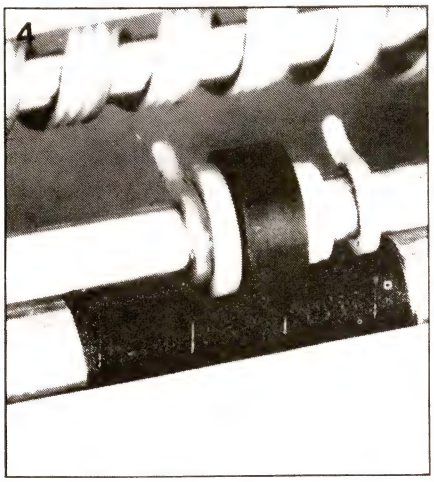


Fig. 4. Close-up of the sandpaper grip on the platen, and the associated pressure roller plus clips on the movable axle. Also note how the 4-way flatcable to the carriage is wound on the rear rod to make a flexible connection with the plotter interface board.

Circuit description of the plotter interface board

The control circuit developed for the plotter is composed of a power supply, two stepper motor drivers, three buffers for energizing the pen lift solenoids, and an 8-bit digital interface to the Centronics standard.

The diagram of Fig. 5 shows that the circuit is based around integrated stepper motor drivers Type MC3479 from Motorola or SGS. Three inputs of each chip, clock, full/half step and direction, are driven direct by the computer via the input connector. The fourth input, OIC, enables selection between high or low impedance termination of the energized stator winding during half step operation. This selection is used for optimizing the dynamic response of the relevant motor. The resistor connected to the SET input of the driver IC determines the stator current. In the non-activated condition, T_4 and T_5 are turned off, so that the resistance between the SET inputs and ground is relatively high. This effectively keeps the stator current between 60 and 70 mA, ensuring a modest total dissipation of the motors and the driver ICs, whilst maintaining sufficient torque to keep pens and paper securely in position. A stepper motor is energized when the interface board receives a positive pulse transition on the relevant clock input (clc 1/2). The associated MMV is triggered, switches on the transistor (T_4 or T_5), and causes the stator current in the motor to rise to about 200 mA per phase. This rush-in current flows only briefly due to the inductance of the stator, and depends on the step rate. The driver IC, however, will counteract this reduction—within the practical limits of the supply voltage—to force a current flow of about 200 mA.

Opening switch S_2 disables the stepper motors to allow manual positioning of the carriage and/or the paper on the platen. In addition, opening S_2 resets the logic circuitry internal to the driver ICs to the initial state, as indicated by the illuminated LEDs. This state occurs at each fourth (or eighth) step, and the LEDs will light correspondingly.

The circuit for controlling the pen lift solenoids is relatively simple. Two-to-four decoder IC_3 selects one of the three pens. When both IC inputs are held logic high, or are not connected, all three pens are lifted. The electromagnets are actuated via darlington transistors and R-C networks. In these, the capacitor ensures a relatively high pull-in current, while the resistor limits the hold current to a level that is just high enough to keep the electromagnet actuated. Flyback diodes are fitted across the coils to suppress induced voltage peaks.

Cutting, drilling, filing...

The mechanical parts are made or purchased as indicated in the Mechanical Parts List and the working sheet of

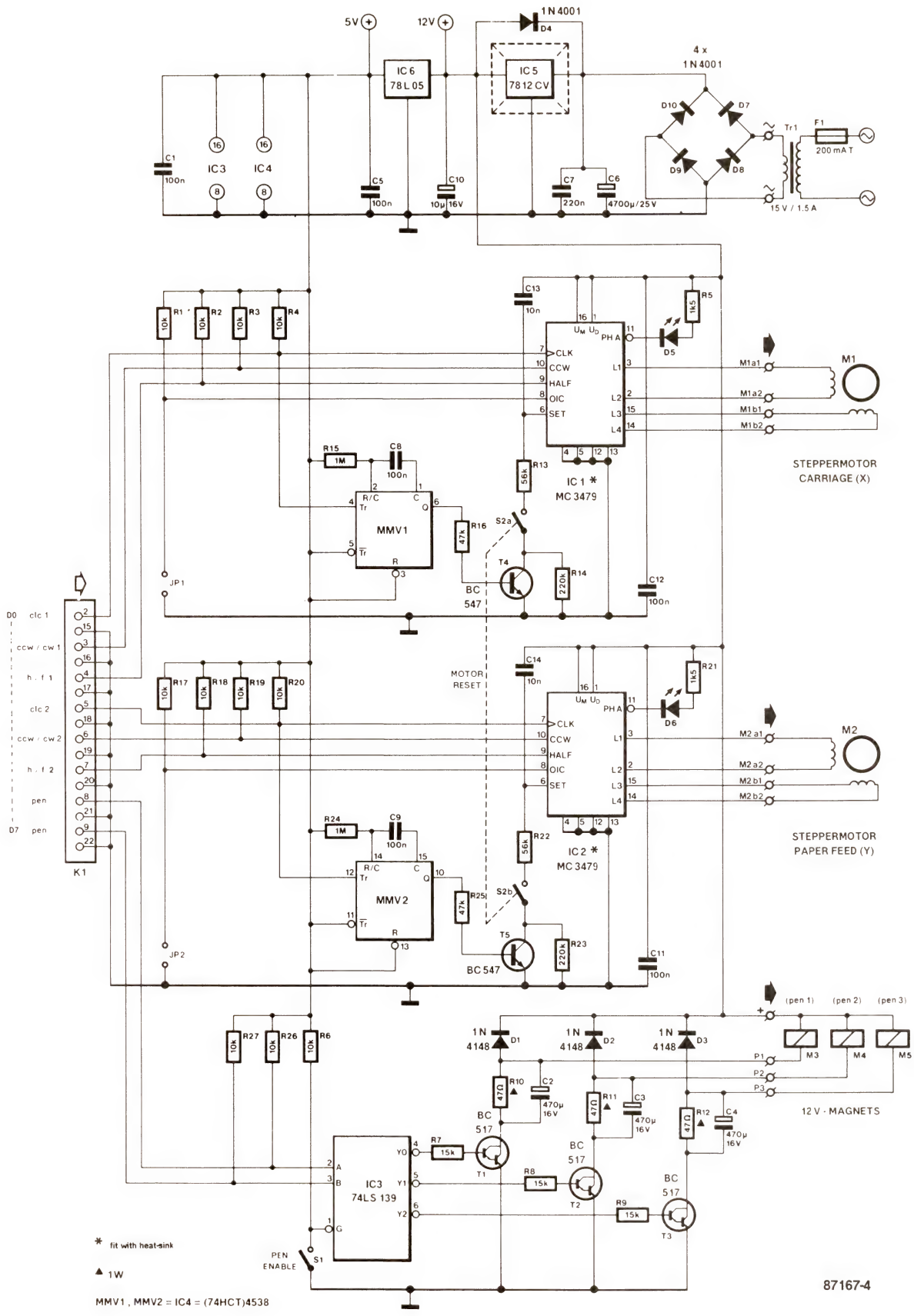


Fig. 5. Circuit diagram of the plotter interface board.

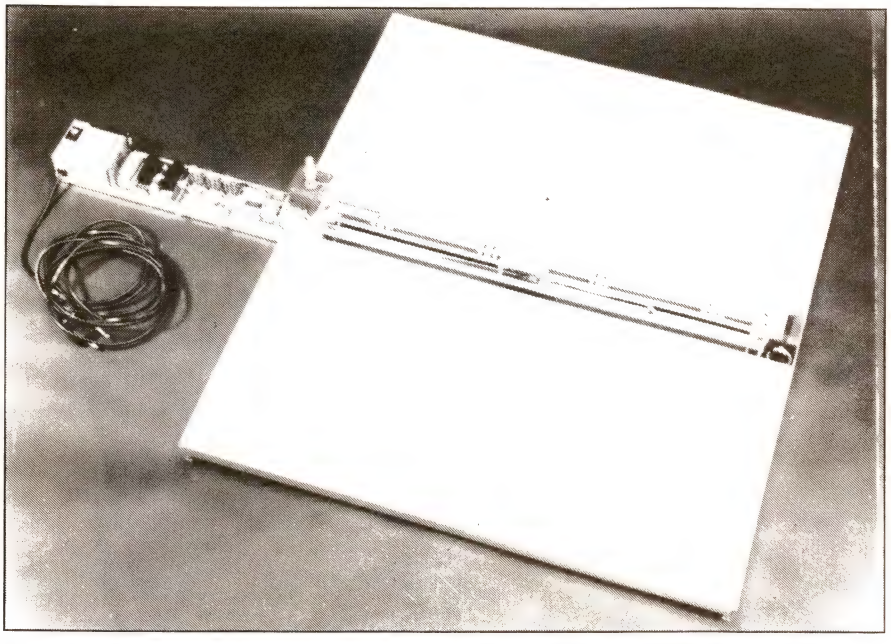
Fig. 3. Each of the 16 parts that must be made to size is shown separately and with the relevant dimensions. The side panels are cut from a 2 mm thick sheet of aluminium. They are preferably clamped together and drilled simultaneously to ensure accuracy. Use a centre punch for precise positioning of the drill, and lubricate this every now and then with methylated spirit to avoid burrs, and to clear aluminium shavings. A countersink drill should be used for sizing the upper hole in the right-hand support plate, which receives the head of the countersunk M4 screw bolt. The head must not protrude from the plate surface because this lies flat against the side of the stepper motor. Two additional 3 mm holes are drilled in the left-hand plate for securing the Y motor. Rods 4, 5, 6 and 7 are cut to equal size as required for the width of the plotter. The centre of both ends of each rod is pre-drilled with a 3.3 mm drill before tapping an M4 thread. Be sure to drill exactly in the centre of the axle: a lathe is, of course, ideal for this operation, but not strictly required for acceptable accuracy.

There is, however, no way to go round the use of a lathe for reducing the platen diameter where the sandpaper is to be secured. Unfortunately, a lathe is neither easy to control nor a commonly available tool. It is, therefore, recommended to have the platen turned to the required local thickness in a mechanic's workshop. Also remember that drilling an off-centred hole in the platen where it is secured to the motor shaft will wreak havoc by causing friction in the nylon bushing at the other end of the rod, and, more seriously, irregular paper motion. The free end of the platen is turned to a diameter of 4.2 mm over 4 mm with the aid of a lathe to enable it to revolve in the nylon bushing. The shaft fitted onto the spindle of the second stepper motor is made by cutting off a short length of the platen tubing. The remaining components, 11...16 incl., are relatively simple to make and require no further discussion.

Construction of the interface

The plotter interface board is a single-sided type which is available ready-made through the Readers Services. Construction is straight-forward by reference to the parts list and the component overlay of Fig. 8. Resistors R_{10}, R_{11} and R_{12} are 1 W types mounted slightly off the board surface to aid in their cooling. Drivers IC_1 and IC_2 require fitting with a DIL clip-on or glue-on heat-sink — see Fig. 6. It is recommended to solder the ICs direct onto the board, so that the ground area can aid in convecting dissipated heat. IC_4 is a type from the 4000 series, and has the disadvantage that its input is not TTL-compatible. In practice, however, pull-up resistors R_4 and R_{20} ensure correct operation of the interface in conjunction with virtually any Centronics port. None the less, when incompatibility problems are suspected (the motors then appear not to start properly), IC_4 may be replaced by an equivalent of the HCT type. Jumpers JP_1 and JP_2 are not fitted.

As already stated, the input header on the board is wired in a manner that facilitates connection to a Centronics port via a length of flat ribbon cable. Handshaking is not used in this arrangement.



Completed prototype of the plotter. This is a relatively wide version (508 mm) mounted on a flat aluminium base plate for improved paper stability (A2 sideways; A3 lengthwise). It has four paper grips to ensure that lines of minimum thickness are drawn reliably and accurately.

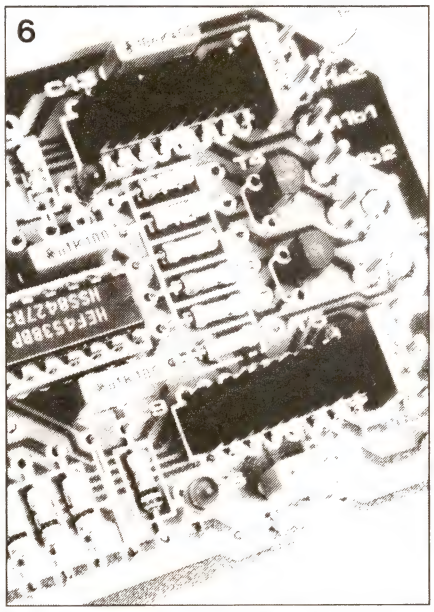


Fig. 6. The stepper motor driver ICs on the interface board require cooling by heat-sinks of a type that can be glued on top of a DIL package.

A note on stepper motors

The stepper motors used for building prototypes of the plotter were Berger types salvaged from discarded disk drives. Similar types may be used if these have the following specifications:

- 200 or 100 steps/rev. (≙1.8° or 3.6° per step);
- current consumption: approx. 200 mA/phase;
- two bipolar phases;
- resistance for each phase (stator): 30...40 Ω.

Unfortunately, many motors may not meet with the above specification in respect of the stator resistance. These types exhibit much lower values (e.g. 1.33 Ω), and require driving from current sources. According to the manufacturers, the driver ICs Type MC3479 on the plotter interface board have current source output stages, but in practice these may be damaged when connected direct to a very low stator resistance. It is, therefore, good practice to check the stator resistance of the motors envisaged for use in the plotter. If necessary, add a suitably dimensioned series resistor tc ensure that each stator output on the driver ICs is loaded with 30...40 Ω. Example: use a 33 Ω; 4 W resistor when the stator alone has a resistance of 1.33 Ω.

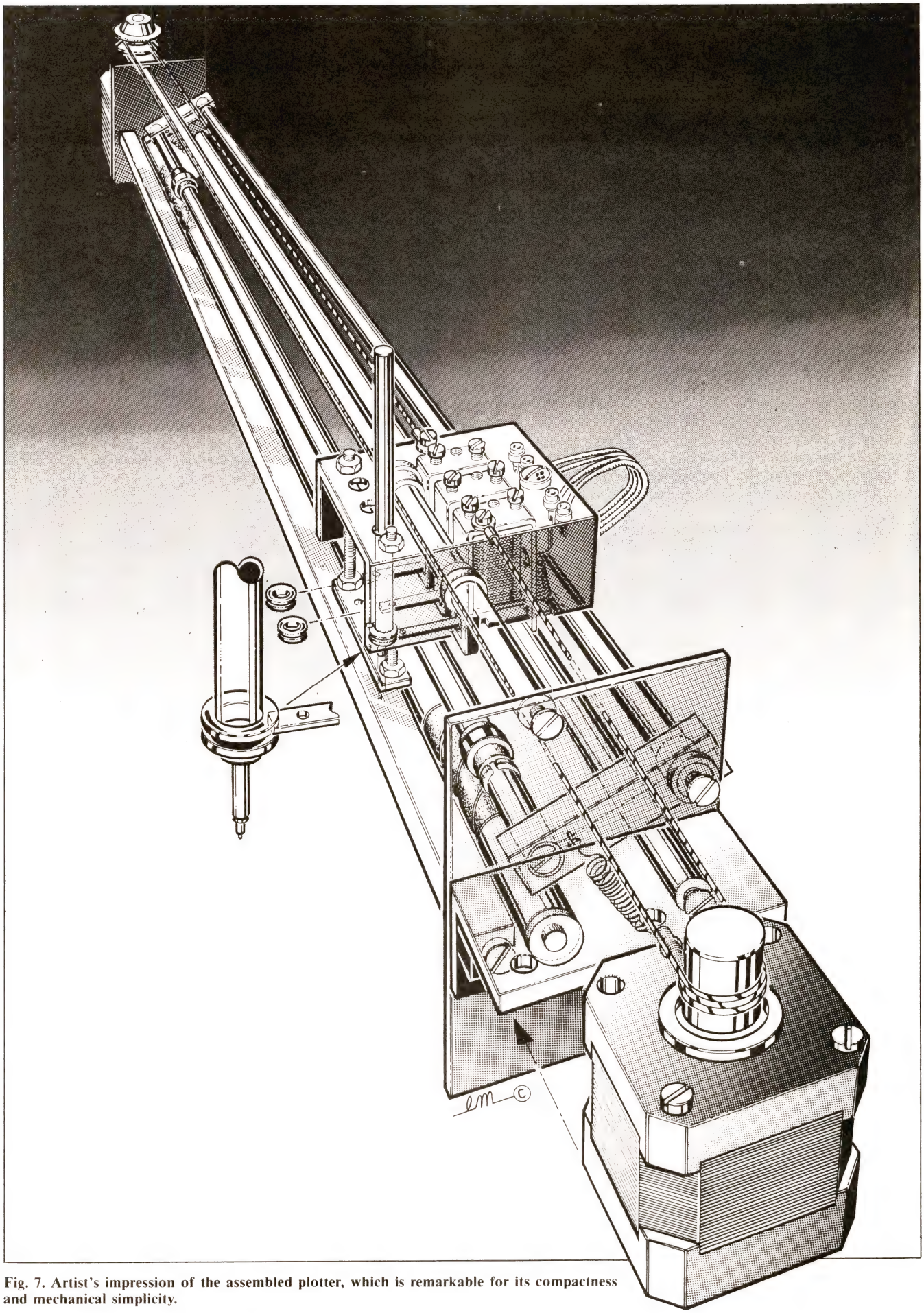
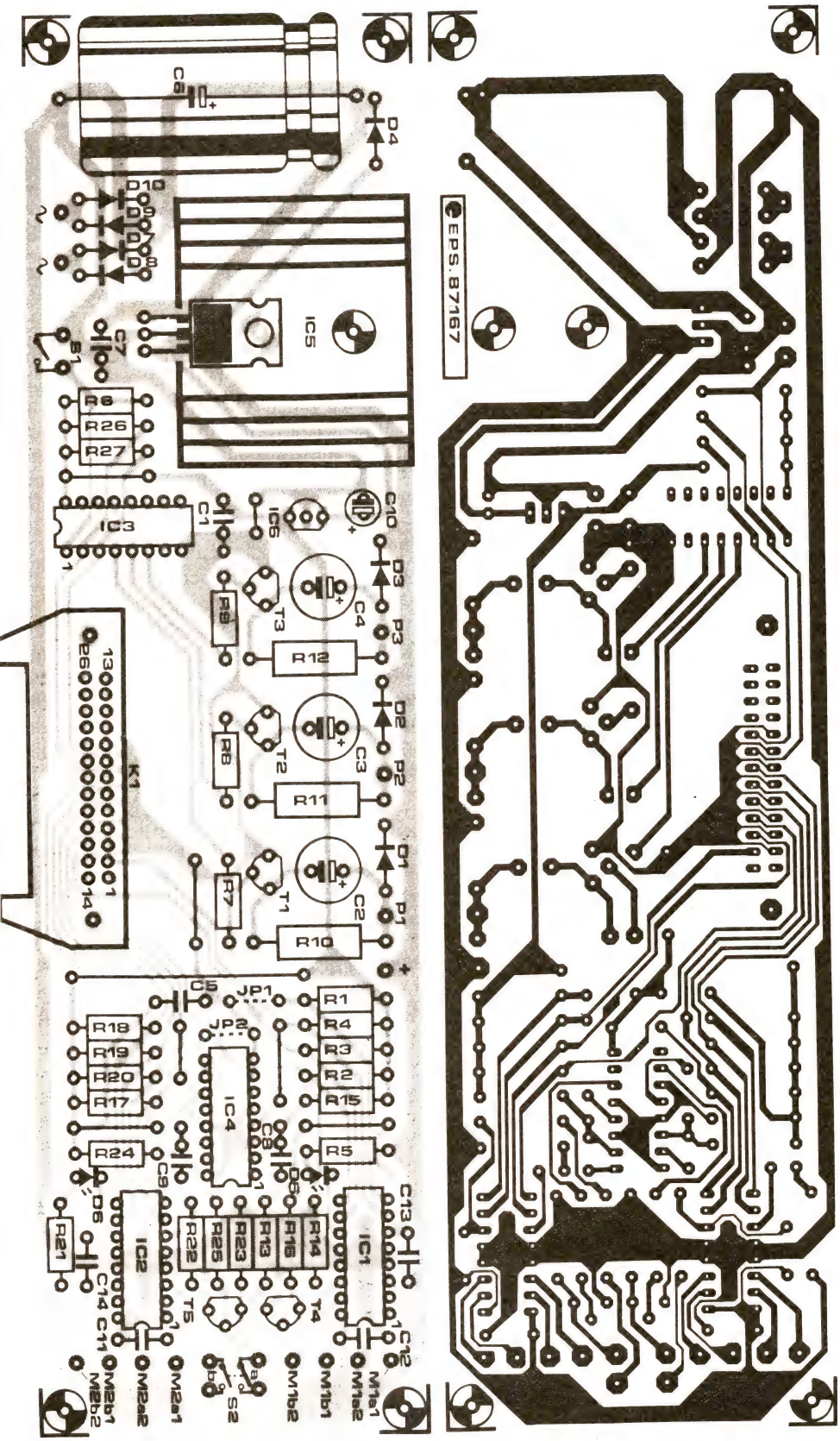


Fig. 7. Artist's impression of the assembled plotter, which is remarkable for its compactness and mechanical simplicity.



Parts list

STEPPER MOTOR INTERFACE BOARD

Resistors (±5%):

R1...R4 incl.;R6;R17...R20 incl.;R26;R27 = 10K
R5;R21 = 1K5
R7;R8;R9 = 15K
R10;R11;R12 = 47R; 1 W
R13;R22 = 56K
R14;R23 = 220K
R15;R24 = 1M0
R16;R25 = 47K

Capacitors:

C1;C5;C8;C9;C11;C12 = 100n
C2;C3;C4 = 470µ; 16 V; radial
C6 = 4700µ; 25 V
C7 = 220n
C10 = 10µ; 16 V
C13;C14 = 10n

Semiconductors:

D1;D2;D3 = 1N4148
D4;D7...D10 incl. = 1N4001
D5;D6 = red LED
T1;T2;T3 = BC517
T4;T5 = BC547
IC1;IC2 = MC3479 (Motorola; SGS)

IC3 = 74LS139
IC4 = 4538 or 74HCT4538
IC5 = 7812
IC6 = 78L05

Miscellaneous:

S1 = miniature SPST switch.
S2 = miniature DPDT switch.
K1 = 26-way right-angled IDC header for PCB edge mounting.
Mains transformer; 15 V/1.5 A secondary.
Euro-style mains entrance socket with integrated fuseholder and switch.
Fuse; 200 mA delayed action.
Heat-sink for IC5.
DIL heat-sinks for IC1;IC2.

Fig. 8. Track layout and component mounting plan for the plotter interface PCB.

NOTE: At time of going to press, we had been unable to convince any local suppliers to support this fascinating and useful project. If you have access to a machine shop, then perseverance will succeed. Otherwise, you might write to the European kit supplier:
Meek-it Elektronica,
Mail Order Service,
Paviljoensgracht 35A,
2512 BL DEN HAAG
The Netherlands.

The completed board is secured onto the mains transformer and the plotter. The two switches are connected as external controls, together with the mains switch. Do not forget the mains fuse, which should be connected ahead of a suitably rated DPDT mains switch. A Euro-style mains entrance socket with integral switch and fuseholder is, of course, the safest and easiest alternative in this respect. Indicators D5 and D6 need not be visible when the interface is fitted in an enclosure, although this may prove useful during testing and setting up.

Part 2 of this article will deal with general condiderations on control software for the plotter.

VLF CONVERTER

Build this 10 MHz up-converter if you are interested in receiving signals from time standard, FAX, RTTY and other utility stations operating in the kilometric bands.

The frequency range from 30 kHz to 150 kHz is generally referred to as the Very Low Frequency (VLF) band. It is used relatively little, because high transmitter powers and large aerial systems are required, which generally give a relatively small coverage (typically about 300 to 1000 km). For a number of applications, this is not considered a disadvantage, however. Propagation of VLF waves is highly predictable, since there is virtually no atmospheric reflection: the transmitter range is, therefore, fairly accurately defined. VLF signals travel almost exclusively via the so-called *ground wave*, while the ground-ionosphere space acts as a waveguide. Thanks to this property of the VLF band, received signals are usually free from phase shift and amplitude variation (fading), so often found on the shortwave bands. The VLF band is well suited to medium-range, one-way data communication, such as time standard transmitters (Rugby GBR, Rugby MSF, Mainflingen DCF77, Prangins HBG), meteorological facsimile, submarine communication, and telex networks. One disadvantage of the VLF band is the huge aerial system required at the transmitter side. Aerial systems of several square kilometres, and with multiple transmitter feed points, are not uncommon, yet attain a. radiation efficiency of only a few percent. At the receiver side, due account should be taken of the high level of man-made noise (computers, neon tubes, TV sets and other electrical appliances). In most cases, the so-called *long wire* is the only feasible aerial at the receiver side. Thirty metres or more of sloping or horizontally running insulated wire, mounted well away from the previously mentioned sources of interference, is recommended for serious experiments in receiving VLF transmissions.

Generally, the lower the frequency, the rarer. and more interesting the stations. Not every communications receiver can be tuned as low as 15 kHz, but this is made possible by the up-converter described here. It effectively converts the frequency range from about 15 kHz...300 kHz to 10 MHz, so that the CW, RTTY, FAX, AM or SSB facilities of the communication receiver tuned between 10.000 and 10.300 MHz can be exploited to receive VLF transmissions.

Circuit description

The VLF converter is an application of the Type NE602 active double balanced mixer and oscillator, whose block diagram is shown in Fig. 1. The chip requires only a handful of external components to make a good-quality up-converter.

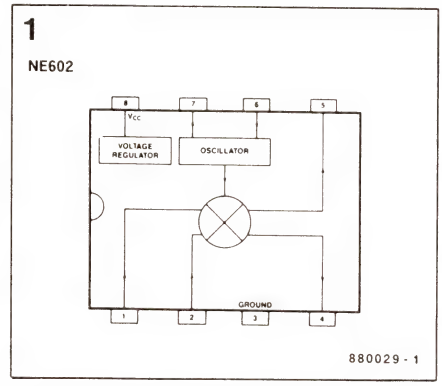


Fig. 1. NE602 integrated active double-balanced mixer/oscillator.

The circuit diagram of the converter is given in Fig. 2. The function of the circuit is to convert the frequency range from 15 kHz to about 300 kHz to an equally large band starting at 10 MHz. The SSB/CW/FAX/RTTY receiver connected to the output of the converter is tuned between 10.015 and 10.300 MHz. A VLF station such as Rugby MSF is, for example, "received" at 10.060 MHz. The VLF aerial signal is passed through low-pass filter L_1-C_2-L_2-C_3-L_3-C_4 that defines the input frequency range (15 kHz...300 kHz). Transistor T_1 forms an impedance transformer between the filter output and one RF input of the active mixer in IC_1. The NE602 is set up in an asymmetrical configuration here. RF input pin 2 is bypassed to ground with C_7, while P_1 is used for setting equal direct voltages at the RF inputs to optimize mixer balance. The output frequency of the local oscillator on board the NE602 is set to 10 MHz with the aid of an external quartz crystal, X_1. Trimmer C_{11} provides a means for accurately setting the LO frequency to 10.000 MHz, so that the tuning scale on the receiver corresponds to the true received frequency, ignoring, of course, the "10" preceding the kHz digits in the read-out.

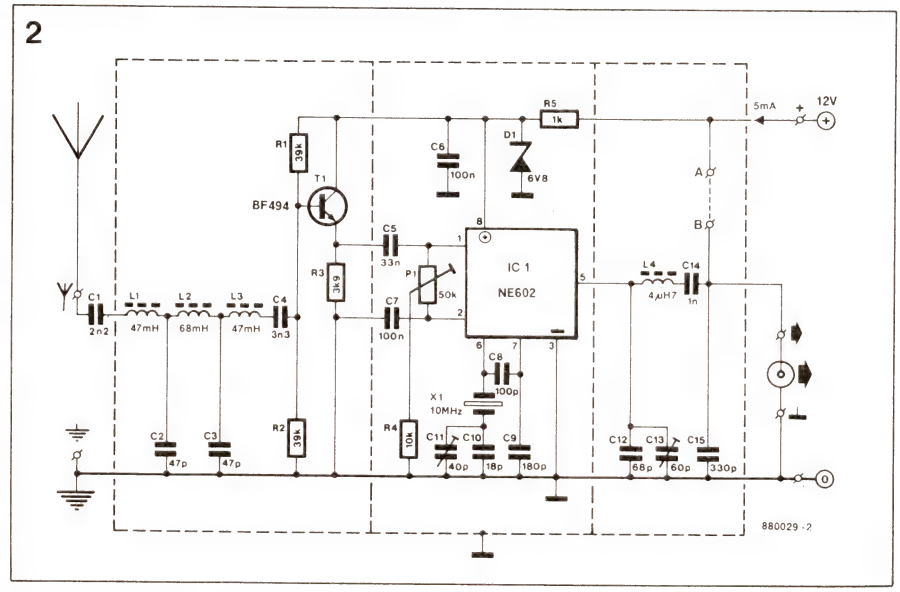


Fig. 2. Circuit diagram of the VLF up-converter.

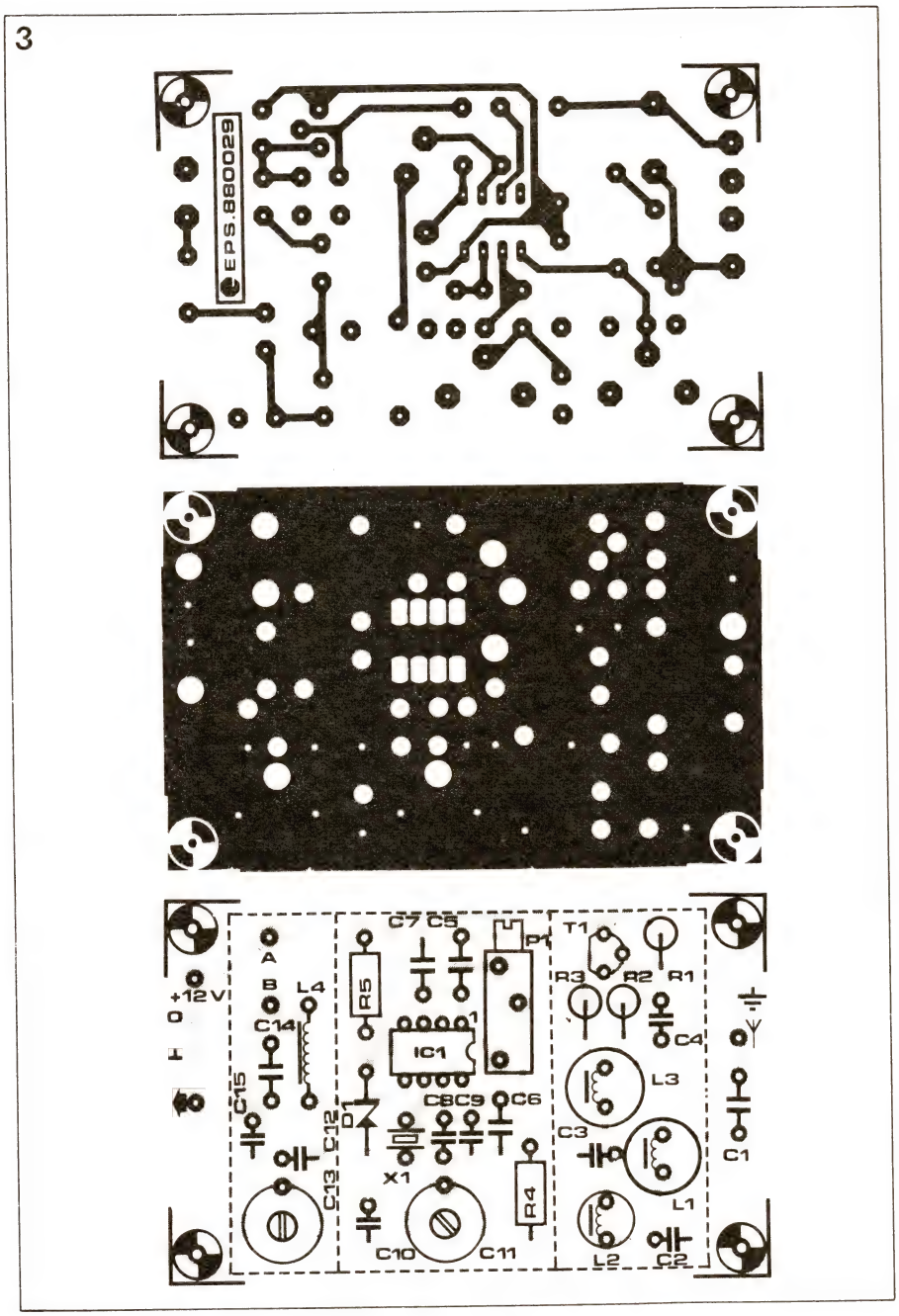


Fig. 3. Printed circuit board for the VLF converter.

Parts list

Resistors (±5%):

R1;R2 = 39K
R3 = 3K9
R4 = 10K
R5 = 1K0
P1 = 50K multiturn preset

Capacitors:

C1 = 2n2
C2;C3 = 47p
C4 = 3n3
C5 = 33n
C6;C7 = 100n
C8 = 100p
C9 = 180p
C10 = 18p
C11 = 40p trimmer
C12 = 68p
C13 = 60p trimmer
C14 = 1n0
C15 = 330p

Inductors:

L1;L3 = 47mH ferrite encapsulated choke for radial mounting: Toko Type 181LY-473 (Cirkit stock no. 34-47302).
L2 = 68mH ferrite encapsulated choke for radial mounting: Toko Type 181LY-683 (Cirkit stock no. 34-68302).
L4 = 4μH7 axial choke.

Semiconductors:

D1 = zenerdiode 6V8; 400 mW
IC1 = NE602 (available from CSI Electronics)
T1 = BF494 (Maplin order no. QQ19V)

Miscellaneous:

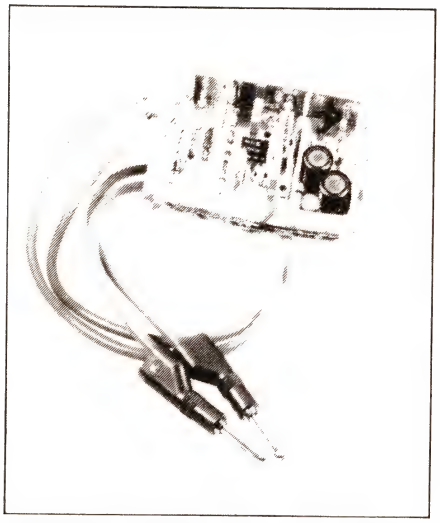
PCB Type 880029 (see Readers Services page).
X1 = 10 MHz quartz crystal; 30p parallel resonant.

The output of the active double balanced mixer is a single-ended configuration. The up-converted frequency band is filtered in pi-section C12+C13-L4-C14-C15 to suppress spurious mixer products. The low-frequency roll-off point of the filter is set to about 10 MHz by trimmer C13. It should be noted that the mixer also generates an image band between 9.985 MHz (10−0.015) and 9.700 MHz (10−0.3), but this of little consequence. The converter is fed from a regulated 12 V source, either via separate supply wires (do not fit link A—B), or via the downlead coax to the receiver (fit link A—B, and make sure that the receiver output voltage is between 10 and 15 V). The mixer/oscillator and preamplifier transistor are fed from a 6.8 V rail created with stabilizer R5-D1.

Construction and alignment

The VLF converter is a simple to build project. The printed circuit board is a double-sided, but not through-plated, pretinned type—see Fig. 3. Commence the construction with fitting 15 mm high brass or tin metal sheet screens as shown on the component overlay. Component leads shown without a small circle are soldered at the track side of the board, and to the ground area provided on the component side. Radial inductors L1, L2 and L3 are ferrite encapsulated types from Toko. The mixer/oscillator, IC1, is fitted direct onto the PCB (do not use a socket). Drill a 2 mm dia. hole in the screen to give access to the spindle of multiturn preset P1. Finally, fit soldering terminals for the input, output and supply connections. Install wire link A—B if the converter is powered via the coax cable to the receiver.

Set P1, C11 and C13 to the centre of their travel. Apply 12 V to the circuit, and check the presence of 6.8 V on pin 8 of IC1. Measure the direct voltage on pins 1 and 2, and adjust P1 until both are held at an equal potential of about 0.8 V. Connect the receiver, and tune this to 10.000 MHz. Mode: CW, BFO off, or to the centre of its travel. Switch on the input attenuator, or select reduced RF input gain. Lower the frequency of the beat note heard to nought by adjusting C11 (zero beat). Connect the aerial to the VLF converter, and tune to a relatively strong transmission at



Completed prototype of the VLF converter. The screening fitted onto the component side prevents oscillation and spurious mixer products.

Frequency	Station	Power	Service
16 kHz	GBR Rugby (UK)	60 kW	time signals during the 5 minutes preceding 03.00h, 09.00h, 15.00h and 21.00h.
50 kHz	RTZ Irkutsk (USSR)	50 kW	standard frequency.
60 kHz	MSF Rugby (UK)	50 kW	standard frequency & BCD time and date signals.
71 kHz	*not identified*		time signals.
75 kHz	HBG Prangins (SUI)	20 kW	BCD time and date signals.
77.5 kHz	DCF77 Mainflingen (FRG)	50 kW	standard frequency & BCD time and date signals.
117.4 kHz	DCF37 Mainflingen		meteorological facsimile.
134.2 kHz	DCF54 Mainflingen		meteorological facsimile.
139.0 kHz	DCF39 Mainflingen		photofacsimile.

Some stations that can be received below 150 kHz.

about 200 kHz (10.200 MHz on the receiver), e.g. Droitwich (AM). Reduce the input gain of the receiver, and peak C_{13} for optimum reception (this adjustment is relatively uncritical).

Stations and services

It should be noted that the VLF converter has some conversion gain, so that every care should be taken not to overdrive the communications receiver. It is, therefore, strongly recommended to make use of the fixed or variable RF attenuator provided on most receivers. The connection between the VLF converter and the unbalanced, low-impedance (50—100 Ω) receiver input must be made in coaxial cable to prevent breakthrough of strong signals in the 10 MHz band.

The frequency assignment used in the VLF band is roughly as follows:

15—100 kHz: submarine communications (CW), beacons and time standard transmitters;
100—150 kHz: RTTY (radio teletype), and meteorological facsimile services;
150—300 kHz: long-wave broadcast services and, occasionally, RTTY.

– REVIEW, from page 83.

aem product review

reasonably sized, ummmmmm . . . . . furry pads. No balls, no axles, no strain, no pain!

At first glance, the size and shape of this mouse may be a bit disconcerting, being somewhat wider and not as contoured as other, more conventional, mice. However, upon using the PC Mouse I found it to be actually more comfortable to use than those supposedly contoured to the human hand.

On the top of the mouse are mounted three push buttons, rather than the conventional two. They have a definite, positive "feel" - you always *know* when you've 'clicked' it!

In use, particularly with the exacting work required with AutoCAD, it's a delight. The cursor movement is precise and predictable – it does exactly what you expect it to do. Everybody who used it, and who had used the digitizer, commented that it was an definite improvement on the digitizer.

What about the "pad". All I can say is, it's extraordinarily robust. In fact, somewhere along the way, somehow the pad found itself on the floor, where it was stood upon – not once, but twice – by a person wearing high-heeled shoes! As a result there are two substantial "dents" or "craters" in the surface of the pad. For some extraordinary reason, these have no noticeable effect on its operation!

The rear surface of the pad is covered in a non-slip material which is very effective in preventing it sliding around the bench or table top.

Bells and whistles

OK, I have now described a mouse, suitable for IBM PCs and compatibles, offering better performance than conventional mice, countering most, if not all, of the drawbacks of mechanical type mice, what else comes with it?

The PC Mouse retails for $249 from Dick Smith Electronics Stores and comes bundled with two software packages. The first, Designer Pop-Up Menus, provides a suite of drivers, needed to interface the mouse to most industry standard software packages, although most programs will accept input from the mouse configured as a "Mouse Systems Mouse".

Designer Pop-Up Menus also allows you to design a hierarchical menu system of 'pull-down' windows. This provides you with the power and flexibility of setting up custom windows containing commonly used commands and phrases in an application that can be selected just by moving the mouse to the top of the screen, at which time an appropriate window will appear offering a range of selections.

The software is supplied with a number of such window systems to get you started. Just imagine, you can jazz-up that aging copy of Wordstar 3.0!

In summary

This product has hidden benefits, not obvious at first look. It has significant advantages over its mechanical cousins and, as we found, may be readily used in place of a more expensive input device where accurate graphics manipulation is required. It's worth the price without the software in such cases.

If you were considering installing a mouse, or thinking of upgrading – don't wait. Get this one.

Jamye Harrison

APPLICATION NOTES

The contents of this column are based on information obtained from manufacturers in the electronics industry, or their representatives, and do not imply practical experience by *Elektor Electronics* or its consultants.

SINGLE-CHIP MULTI-STANDARD COLOUR DECODER

In areas where TV transmissions to more than one colour standard can be received, colour receivers are required which can handle multistandard transmissions without additional manual switching. This requirement will greatly increase with the introduction of satellite TV.

Such receivers have, in the past, incorporated a multi-standard colour decoder (MSD) using several integrated circuits to automatically select the standard of the received signal. However, the growing need for these MSDs makes it economically and technically desirable to incorporate all the active parts in one IC and to reduce, as far as possible, the external circuitry.

This application note describes two new single-chip MSDs using bipolar technology, the TDA4555 and TDA4556. The ICs are similar except for the polarity of the colour difference signals at the output. The TDA4555 provides $-(R-Y)$ and $-(B-Y)$ signals; the TDA4556 provides $+(R-Y)$ and $+(B-Y)$ signals. Only the TDA4555 will be described.

The ICs are universally applicable and allow the design of a range of TV receivers having a common main chassis. Automatic selection of the required standard has been made more reliable and the maximum time required for identification and switching is a little over half a second.

When reception is difficult because signals are weak, noisy, or badly distorted, the automatic standard recognition (ASR) can be switched off and the standard chosen manually.

Figure 1 is a block diagram of a typical multi-standard colour decoder incorporating the TDA4555. The composite video input signal (CVBS) is fed via switchable filters to the input of the MSD. The filters separate the chrominance and luminance signals according to the standard selected, which, for ASR, is controlled by the colour decoder IC.

Chrominance signals from the filters are AC coupled to the input of the TDA4555, which produces the colour difference outputs, that are, in turn, AC coupled to the Colour Transient Improvement (CTI), part of the TDA4560. This IC also contains an adjustable delay-line formed by gyrators, so a conventional wirewound delay line is not needed.

The signals are then fed to the Video Combination IC, TDA3505, which converts the colour difference signals $-(R-Y)$ and $-(B-Y)$ and the luminance signal (Y) into the RGB signals. The TDA3505 also incorporates the saturation, contrast, and brightness control circuits and allows for the insertion of external RGB signals. Finally, the processed video signals are applied, via the RGB output stage to the picture tube.

The new MSD can decode colour TV signals transmitted according to the following standards:

A. QAM (Quadrature Amplitude Modulation of the colour carrier by the colour difference signals).

1. NTSC standards with any colour subcarrier frequency, for example
— NTSC-M (f_o = 3.579 545 MHz), referred to as NTSC-3.5
— Non-standard NTSC systems, for example with $f_o = f_{oPAL}$ = 4.433 618 75 MHz.
This system is used in the United Kingdom and in the Near East and is referred to as NTSC-4.4. As the colour subcarrier frequency is the same as that of the normal PAL system, the same crystal can be used without switching in the reference oscillator for both systems.

2. PAL standard, characterised by phase reversal of the (R−Y) signal on alternate scan lines. The colour subcarrier frequency for normal PAL is 4.433 618 75 MHz.

1

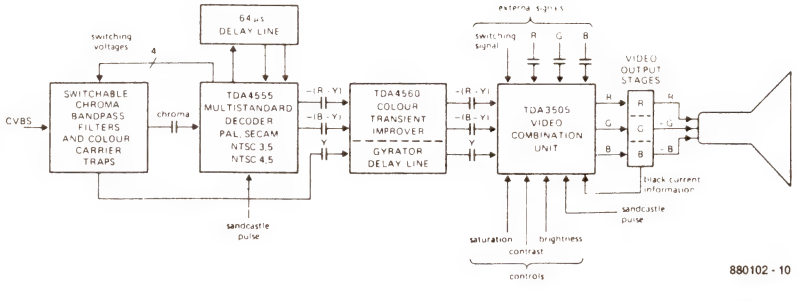


Fig 1. Block diagram of a multi-standard decoder incorporating the Type TDA4555.

B. SECAM characterised by transmission of the colour difference signals (R–Y) and (B–Y) on alternate scan lines and frequency modulation of the colour subcarriers. The frequency of the colour signals may vary between 3.900 MHz and 4.756 MHz. The frequencies of the colour subcarriers are:

f_{oB} = 4.250 MHz for a "blue line"

f_{oR} = 4.406 25 MHz for a "red line".

With these capabilities, the new decoders can handle most of the colour TV transmissions in central Europe and also in other areas.

TDA4555 circuit description

Figure 2 is the circuit of a multistandard colour decoder using TDA4555/56.

The IC only requires a single sandcastle pulse at pin 24 for the generation of all internal pulses (e.g. burst key, horizontal and vertical blanking pulses). The sandcastle pulse levels are >8 V for the burst key; 4.5 V for horizontal blanking: and 2.5 V for vertical blanking.

Level detectors in the sandcastle pulse detector separate the three levels which are used to generate the required key pulse and clamp pulses.

A special System Control and Standard Scanning circuit (SCSS) provides the switching voltages to set the MSD to the desired standard.

As long as no colour standard is recognized, the SCSS circuit switches the decoder sequentially to the PAL, SECAM, NTSC-3.5 and NTSC-4.4 standards. If the standard of the received signal is not recognized after four field periods (80 ms), the next decoding system is activated. This time interval, also called the standard scanning period, is a good compromise between fast switch-on of the colour and effective interference suppression with noisy signals. The maximum time between the start of scanning and switching on the colour is 360 ms, including the colour switch-on delay of two field periods. However, in the TDA4555, a PAL priority circuit is incorporated to improve the reliability for SECAM, so the scanning can last for another two scanning periods (520 ms maximum).

After recognition of a SECAM signal, the information is stored and the decoding is switched to PAL. A second SECAM recognition is only provided if no PAL recognition occurs. This gives reliable SECAM recognition when the SECAM-PAL transcoding at the source (e.g. in cable systems) is not perfect, or when PAL signals are distorted by reflections so that they simulate SECAM signals.

With b/w signals, the scanning is continuous and the colour is kept switched off because there is no standard recognition.

The switch voltage corresponding to the recognized standard ramps from 2.5 V to 6 V during scanning and the remaining switch voltages are held at 0.5 V maximum. These voltages are used to switch the filters at the input, the crystals of the reference oscillators, and the colour subcarrier traps, and also to indicate the recognised standard (e.g. by LEDs).

To prevent unnecessary restarting of scanning because of momentary disturbances (e.g. short-term interruptions of the colour signal), the TDA4555 incorporates a delay of two field periods (40 ms) before scanning can start.

Finally the IC allows the automatic standard recognition (ASR) to be switched off by applying external switching signals and forcing one of the decoding modes by applying at least 9 V to the appropriate pin (25...28 incl.). These pins also serve as outputs for the internally generated switch voltages which indicate the selected standard. The automatic colour switch-off is active in both cases.

The MSD must provide colour-difference output signals with an amplitude referred to a given test signal, despite amplitude variations (within

2

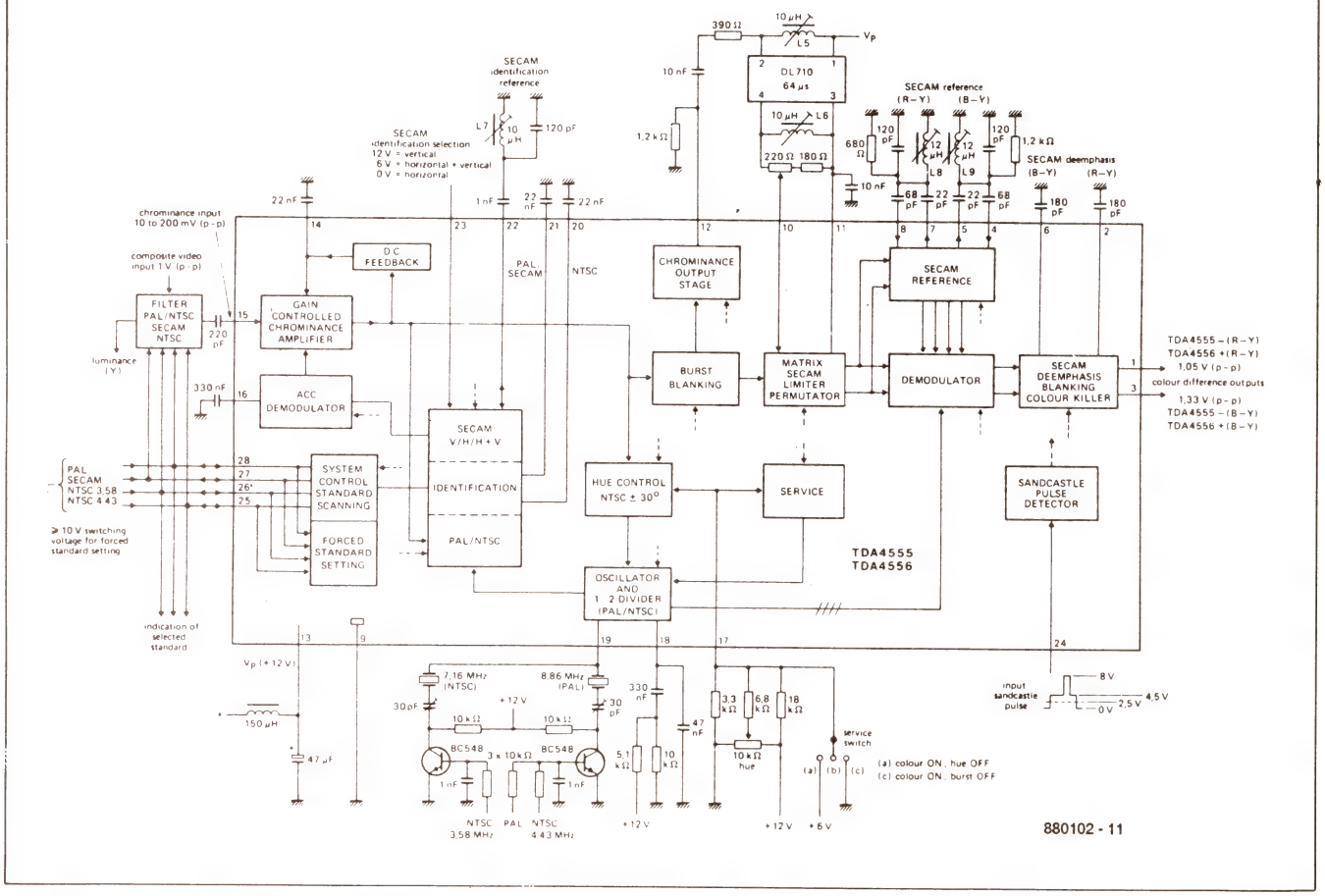


Fig. 2. Block diagram and peripheral circuitry.

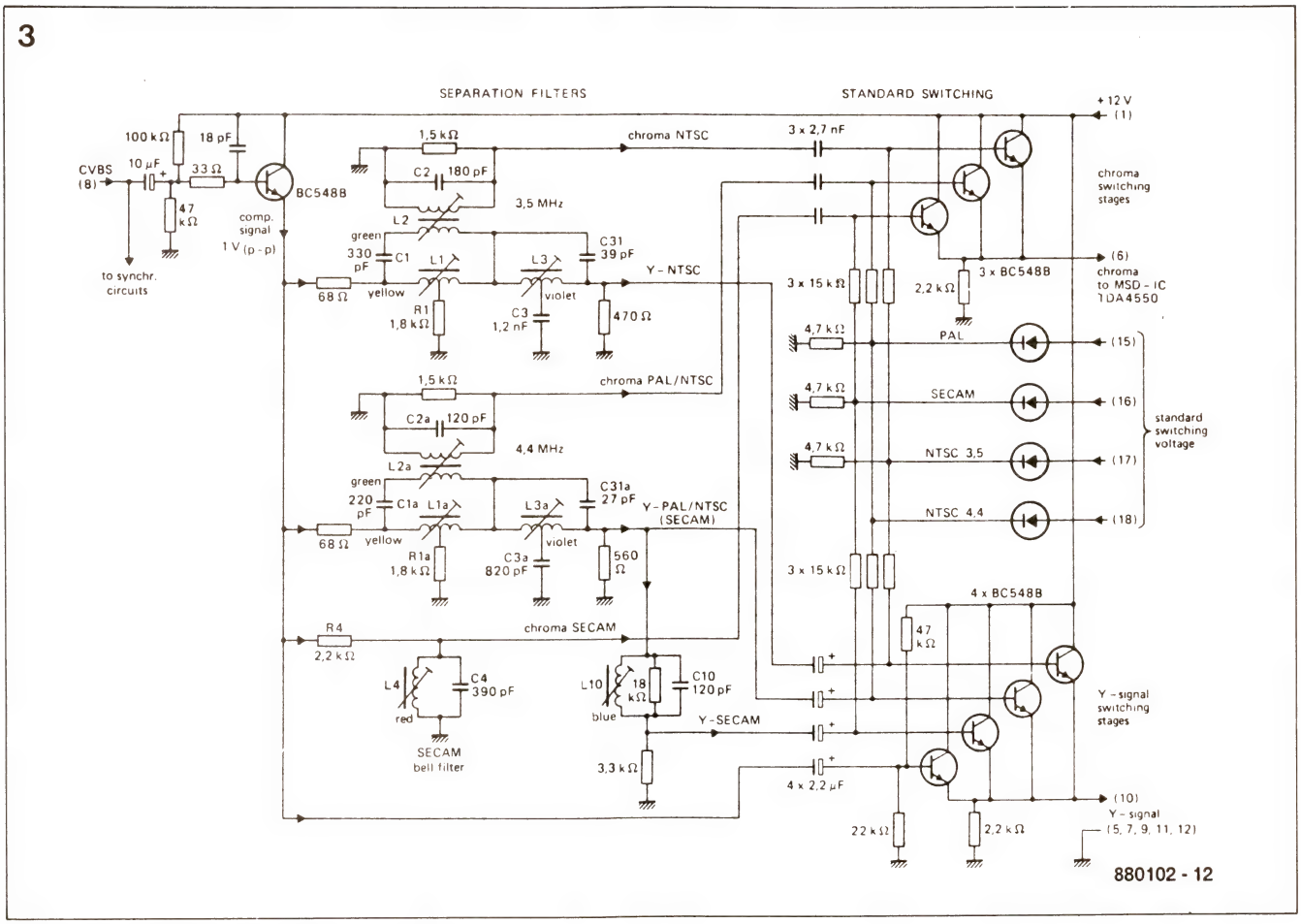


Fig. 3. Circuit diagram of the filter input section.

limits) of the colour input signal. This is required to maintain a fixed amplitude relationship between the luminance signal (Y) and the colour-difference signals, independent of different i.f. filters or receiver detuning. The TDA4555/56 incorporate an Automatic Colour Control circuit (ACC) for this purpose.

Circuit example

Figure 2 is a tested circuit of a multistandard decoder. A more detailed circuit of the input filters is shown in Fig. 3. These filters separate the luminance signal (Y) from the colour signals for the four decoding modes.

The same filters can be used for PAL and NTSC-4.4 signals since they have a similar frequency spectrum. For SECAM signals, it is possible to use the 4.4 MHz subcarrier trap of the PAL/NTSC-4.4 filter but it is then necessary to add a trap tuned to about 4.05 MHz in the Y channel. This filter suppresses the colour signal components below about 4.2 MHz which mainly occur during the "blue SECAM line".

In the case of PAL and NTSC, the reference for the control is the burst amplitude. For SECAM, the complete colour signal is used. The colour signal is AC coupled, via pin 15, to a gain-controlled amplifier and the control voltage is obtained by in-phase synchronous demodulation of the burst or the colour-signal.

This approach has the advantage that the same demodulator, having only one external capacitor at pin 16, can be used for all standards and also results in noise reduction with noisy signals. Unwanted increase of saturation with noisy signals (colour bright-up effect) is prevented without an extra peak detector being required.

Table 1

Coil data for the multi-standard decoder of Fig. 2 and Fig. 3

coil no	inductance (µH)	Q	toko type no.	no. of turns	colour	use
L_1/L_{1a}	5.5	>90 (4.4 MHz)	119 LNS-A 4449 AH	8+8	yellow	separation filter
L_2/L_K L_{2a}/L_{Ka}	12.5	>90 (4.4 MHz)	119 LNS-A 4451 DY	24/1	green	colour bandpass filter
L_3 L_{3a}	66.0	60 (2.52 MHz)	KANS-K 4087 HU	19+46*	violet	phase delay correction
L_4	3.8	60 (4.4 MHz)	113 CNS-2 K 843 EG	17 (=14+3)	red	bell filter
L_5, L_6, L_7 & L_{10}	10.0	>80 (4.4 MHz)	119 LN-A 3753 GO	11+11	blue	decoder board and SECAM trap for f_{ob}
L_8, L_9	12.0	>80	119 LN-A 3753 GO	12+12	blue	decoder board

Source: Philips Technical Publication 169.

COPPER-ON-CERAMIC MICRO-ELECTRONIC TECHNOLOGY

by Harry Cole, CEng, MIERE

As the technology of modern micro-electronic circuitry advances, so too does the need to convey digitally coded signals at ever increasing rates. This requirement assumes considerable importance in the multi-layer type of circuit board where many widely spaced ICs have to be interconnected with negligible loss of amplitude.

Traditionally, gold has been used for interconnection purposes in chip carriers intended for military and aerospace applications where high reliability is of prime importance. Unfortunately, the relatively high electrical resistivity of gold (0.02 $\mu\Omega$ m) and the need for thinner interconnections makes this material unsuitable for the interconnection of densely packed ICs.

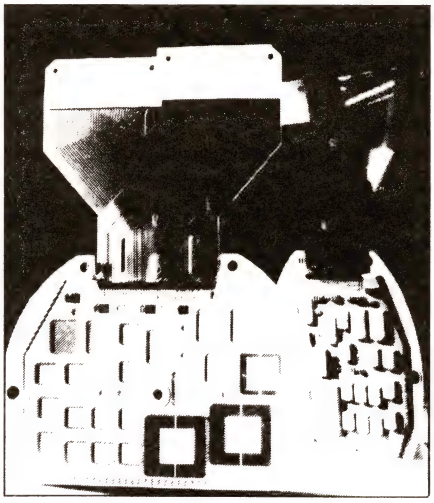
Copper, although lacking some of the desirable properties of gold, has a resistivity of 0.016 $\mu\Omega$ m which is considerably lower and has good solderability. It is much cheaper and has good adhesion properties when bonded to circuit board materials.

The Micro-electronics Technology Centre of British Aerospace's Air Weapons Division at Hatfield has devoted considerable research into the use of copper interconnections laid down on substrates formed of aluminium oxide ceramic. It has developed a fully documented repeatable process that can produce substrates in a variety of flat rectangular sizes up to 152 mm × 183 mm.

Glass sealing glaze

After being processed, the substrate can be machined by laser beam to virtually any shape, complete with access holes as required. The circuit interconnections are laid down on the ceramic substrate using screen printing technology, and circuit tracks as thin as 0.18 mm can be produced.

Each circuit board may have up to six separate conducting layers, including gridded power and ground (earth) planes, the top layers containing the electrode attachment pads for the components to be fitted. Electrical isolation between the copper conducting layers is achieved by printing from two to five layers of dielectric material, the final thickness being tailored to suit the required insulating properties of the circuit being constructed.



Double sided copper-on-ceramic electronic module.

Interconnection between various metal layers is achieved by the printing of copper connector "slugs" in an isolation window cut into the dielectric insulation. This form of connection is known as a "via".

The final printed layer of each board takes the form of a high glass content glaze that effectively seals all preceding conductor layers from environmental hazards during subsequent manufacturing processes. A complete circuit may undergo as many as 50 screen printing operations and 30 separate firing cycles. During each firing cycle the printed substrate is subjected to a temperature profile that peaks at about 900 °C.

Special furnace

In the atmosphere of a conventional furnace such a temperature would cause the printed copper to oxidize, with consequent degradation of its electrical performance and solderability. For this reason, copper printed substrates are fired in an inert nitrogen atmosphere containing a critically controlled doping level of oxygen. The special furnace was designed in-house by the Microelectronics Technology Centre at Hatfield.

When manufacture is complete, the printed substrate is subjected to a rigorous programme of bare-board electrical tests to verify the correctness and continuity of its circuit and connection patterns.

A wide variety of components can be accommodated on the printed substrate, including ceramic and tantalum chip capacitors and leadless chip carriers containing up to 68 connection pins (this capability will shortly be expanded to accommodate larger chip carriers with up to 84 pins). The chip carriers referred to here are rectangular in shape and have connection pads located along all four sides spaced at pitch intervals of 1 mm or 1.27 mm.

A particularly valuable advantage of packaging ICs inside chip carriers is that it enables them to be fully tested and qualified prior to being mounted on the ceramic circuit board.

Easier flux clearance

Once the ICs and components have been assembled on the board they are restrained by an elastomeric fixative and then soldered into position by the technique of reflow soldering. Because the body of the chip carrier is made from a ceramic material similar to that from which the circuit substrate is made, it has similar thermal characteristics and the soldered joints are not subjected to significant thermally induced stresses.

The process developed by the Microelectronics Technology Centre for the attachment of components to circuit boards results in a controlled stand-off (board clearance) height for the mounted components of about 380 mm.

The advantages that come from such a clearance are that they ease the clearing of flux residues from under the components and make possible the close inspection of solder joints by either normal visual means or new techniques such as X-ray microfocus. This type of inspection is not possible without stand-off height.
The complete clearance of flux residues is highly desirable since the presence of such contaminants can pose a serious risk to long-term reliability.
External connections to the circuit board are made by a surface-mounted connector with soldered joints formed by reflow soldering.
There are essentially two methods of assembly adopted by the Micro-electronics Technology Centre. The first makes use of a single sided board fitted with metal edge supports so that the ceramic board can be inserted directly into a standard Eurocard rack. The second method takes advantage of the good thermal conductivity of the aluminium oxide ceramic substrate and uses it as a heat sink for two fully assembled ceramic boards mounted back-to-back on either side of an aluminium core plate.

Punishing tests

The plate functions as both a structural support and a very efficient heat sink. This form of assembly is used where space is restricted. The heat-removing properties of the assembly are further enhanced by the use of high thermal conductivity material for the elastomeric adhesive employed for component placement and for attaching the boards to the core plate.
Circuit board assemblies using the back-to-back method of mounting have been subjected to an independent series of tests carried out by the Components Evaluation Department of British Aerospace's Air Weapons Division.
The tests, which are punishing to any electronic assembly, have included operating temperatures ranging from −55 °C to 125 °C; damp heat storage at 85% relative humidity at 85 °C for 1000 hours; a one minute acceleration of a gravitational force (g) of 1000 (9806 metres per second per second); 400 temperature cycles ranging from −55 °C to 125 °C with ten minutes dwell time and five minutes transfer time; and 100 cycles of ambient power cycling for 15 minutes each side when dissipating 130 mW/cm². As if this was not enough, low frequency power cycling was imposed at 130 mW/cm², and switched on and off repeatedly for 20 temperature cycles.

Automated manufacture

In addition, high frequency power cycle was superimposed on 70 temperature cycles while power at 130 mW/cm² was switched on and off at one minute intervals.
In addition to its design and manufacturing capabilities at Hatfield, the Micro-electronics Technology Centre can also undertake the modification and repair of fully assembled boards. It can, for example, remove and replace all sizes of leadless chip carriers, chip capacitors, chip resistors and flat conductor cable, and cut and isolate copper track.
Work is under way to commission an automated production facility dedicated to the manufacture of copper-on-ceramic multi-layer modules using the operating experience acquired from the company's existing design and manufacturing service.

Micro-electronics Technology Centre, British Aerospace PLC, Air Weapons Division, Manor Road, HATFIELD AL10 9LL.

BREAKTHROUGH IN SUPERCONDUCTING MATERIALS

by Peter Hartley, MIMGTechE

One of the technological sensations of the past eighteen months has been the race towards the first effective room temperature superconducting material. Apart from achieving reliability, one of the major problems is how to fabricate useful products on a commercial basis from the new breed of ceramic materials.

Basic Volume [1], a specialist sensors and electronics materials company, claims to have produced the world's first superconducting solenoid in a ceramic material. This development could start an avalanche of applications for superconducting ceramics.
Superconductivity, the phenomenon in which a material loses all its resistance to electric current, was until comparatively recently observed only at temperatures below −250 °C. This required the use of liquid helium as a coolant.
In February 1987, however, Dr Paul Chu at the University of Houston in the United States discovered a ceramic compound that superconducts at −183 °C, consisting of yttrium, barium, copper and oxygen. This opened up the possibility of using liquid nitrogen, which boils at −196 °C and is much cheaper to use than helium as a coolant.

Single-turn solenoid

Basic Volume, which manufactures solid-state chemical sensors and signal process electronics, was actually producing some of the materials used for superconductivity researches enabling the company's Dr Tim Tavares and his team to experiment with materials that were available immediately.
In March 1987, the company was able to produce samples of $Y_{1.6}Ba_{0.4}CuO_{4-x}$ with a superconductivity transition temperature of −213 °C, and this was rapidly improved upon with its so-called YBC0123 compound in April.
On 24 April, after three previously unsuccessful attempts, the company managed to produce a ceramic superconducting single-turn solenoid. This was made of YBC0123, measured 90 mm long with a 14 mm outside diameter and a radial thickness of 3 mm. The device's material was also, unlike some other similar materials, stable in water.
This development means that many commercial applications of the new nitrogen-cooled ceramic supercon-

ductors are months rather than years away. Among the uses immediately envisaged are: nuclear magnetic resonance equipment, magnetic mineral separation, magnetic bearings, high torque dc electric motors, spin resonance spectroscopy equipment, and electronic imaging apparatus.

Metal matrix composites

Dr James Watson of Southampton University, a specialist in the magnetic separation of minerals, has been supplied by Basic Volume with tubes of $YBA_2\ CU_3\ O_{6.5\text{-}7}$ superconducting ceramic. These tubes, which are 37 mm in diameter, 90 mm long and 1 mm thick, superconduct reliably at temperatures up to −196 °C.

He finds that the material supplied to him by Basic Volume provides a much higher density than competitive products — 90% of the theoretical maximum — and allows current carrying capacities up to 5×10^4 A/cm^2.

Superconductors may have made the technological headlines during the past year, but an equally exciting engineering materials development has been that of the commercialization of metal matrix composites.

To most engineers, the word composites conjures up the image of plastics reinforced with glass or carbon fibres. In these materials, the fibres confer strength to an otherwise mechanically weak material. The fibres take the load and the polymer matrix serves to distribute this load equally between them.

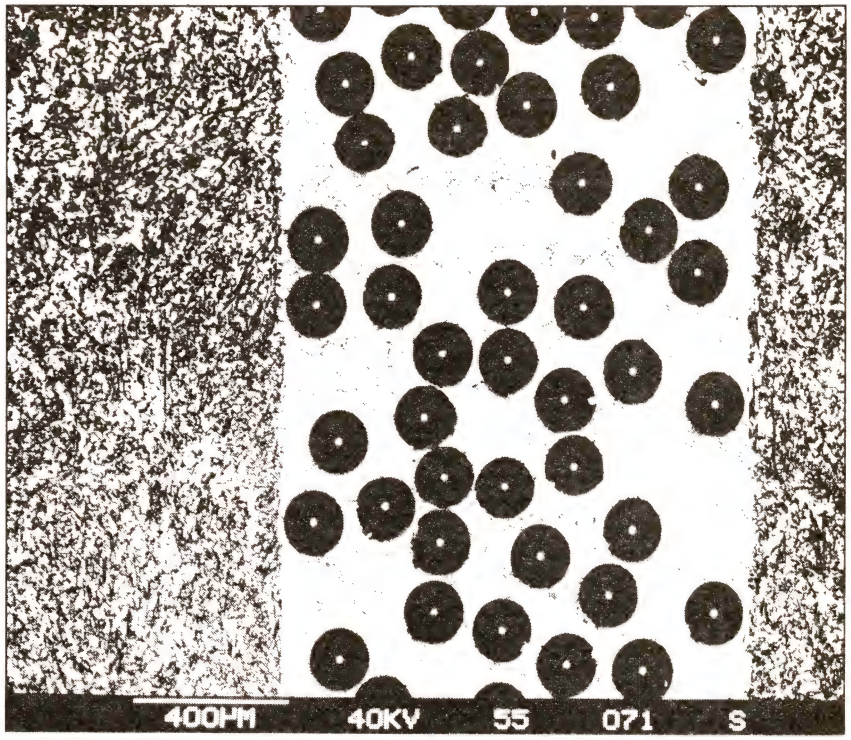
Large capacity production

The same principle is used in a family of new materials — metal matrix composites (MMCs) — in which a metallic phase (the matrix) is reinforced by very strong ceramic or metal fibres, whiskers or particles.

In 1984, the British Collyear Committee Report on new engineering materials and processes states that the key areas for development in MMCs were concerned with the technology of producing them in tonnage quantities.

This is an aim towards which the Metals Technology Centre at the Harwell Laboratory [2] is deeply committed. The so-called MMC Club, organized by, and centred on, Harwell, is carrying out research into titanium-based MMCs within the framework of the European Community's BRITE (Base Research in Industrial Technologies) programme.

Cray Advanced Materials [3], backed by the Cray Electronics Group, was formed some 18 months ago to exploit MMCs commercially. The company operates under a licensing agreement from Britain's Ministry of Defence and uses the patented liquid pressure forming (LPF) process, a new technique for making components from fibre-reinforced metals.



A metal matrix composite containing a hybrid of short 3 μm diameter alumina fibres and silicon carbide coated boron fibres.

Producing complex shapes

Commercial applications of MMCs, currently at the feasibility demonstration stage, include: components for the automotive industry such as pistons, connecting rods, brake callipers, and wheels; gas cylinders; marine propellers; armour plate; lead battery plates; bicycle frames; robotic arms; overhead pantographs for electric trains; and specialist tools.

The LPF process is a technique for the production of ceramic fibre-reinforced metal components to net shape or near net shape, with excellent dimensional tolerances and exceptional mechanical properties.

Various types of ceramic fibre, such as silicon carbide, alumina, boron and carbon, can be used with metals such as aluminium, magnesium, lead zinc or copper alloys.

The Cray LPF process can be used to produce complex shapes that vary in size from a few centimetres up to 2 m × 1.5 m × 1.5 m. It is essentially a single-batch process that produces a net-shaped reinforced component with tolerances in the region of ± 0.2%. Production times are relatively short and die costs low for the volume output.

Glass ceramics

Ceramic Developments (Midlands) Ltd (CDML) [4] is carrying out a range of investigations into the engineering applications of glass ceramics. These differ from true glasses in being polycrystalline ceramics resulting from the crystallization of glasses.

They differ from traditional engineering ceramics in that the starting material is nearly always completely amorphous and not the product of the liquid phase sintering of ceramic precursors.

CDML has carried out an internal development programme aimed at producing a range of photomachinable glasses and glass ceramics with differing expansion coefficients in the range 7×10^{-6}/°C to 11×10^{-6}/°C.

Augmented by CDML—funded research at Sheffield University this has led to the development of a useful range of materials with potential for:

- micro-electronics substrates where high densities at fine holes are needed for interconnection;
- plasma display panels;
- competition with low volume production of ceramic components but giving higher precision without prohibitive tooling costs.

Potential applications

The Department of Trade and Industry has recently awarded the company a

grant of £28,000 to further this project. Glass ceramics developed at CDML show abrasion resistances comparable to that of boron carbide. Potential applications for this material are pipe linings, the coatings for moving parts operating in abrasive environments, and possibly the plasma spraying of large metal components in situ. According to Dr Ronald Jones, CDML's managing director and founder, the firm is now at the stage of being able to cast glass ceramic pipes centrifugally.

One of the most impressive results of work at CDML has been the successful development of glass ceramic armour that shows a similar ballistic performance, thickness-for-thickness, to that of alumina, when used as a protection against 7.62 mm calibre rifle bullets.

The real advantages, however, are weight saving — since the ceramic glass has a density of only 2.4 g/cm^3 as opposed to 3.8 g/cm^3 for alumina — and relatively low processing costs.

Screening equipment

A further useful development at CDML has been the production of very high-quality glasses and glass ceramics by Sol-Gel technology. This involves polymerizing the silicate networks from ethoxysilanes by condensation polymerization. The resultant glasses have a very high surface area tension and can be densified by heat treatment at about 500 °C. This enables glass to be made for catalyst supports, barrier layers and coatings, which are almost impossible to produce by conventional fusing of oxides.

CDML is also researching the use of glass ceramic materials for use as strong, heat-dissipating substrates for thick-film circuitry. The company has formed a consortium with Thorn-EMI, Lucas, Wade and Engelhard, to develop and exploit its work in this area.

Another area of United Kingdom electronics materials development has been in the field of screening equipment against electromagnetic interference (EMI) and radio frequency interference (RFI). Thus, in anticipation of new and tougher European Community legislation on allowable levels of electromagnetic noise emissions from equipment, Shipley Europe [5] has introduced a new EMI shielding technique based on the firm's well established electroless plating technology.

Longlasting adhesion

The chemical process involved deposits uniform thicknesses of copper and nickel coatings on all component surfaces to give, it is claimed, a 40 dB improvement in attenuation of EMI over previous methods such as arc spraying of zinc or the use of conductive nickel paints.

Since copper is a better electrical conductor, it provides maximum protection with a fraction of the thickness used with other methods, resulting in lighter fabrications and greater cost savings. Shielding effectiveness is greater than 80 dB with a copper thickness of only 625 μm.

Total immersion in a series of chemical treatment baths ensures that all surfaces, no matter how complex, receive a uniform coating of metal. Pre-cleaning and etching give long lasting coating adhesion and ensure, it is claimed, that electroless shields will not crack or flake the way some arc sprayed zinc coatings can.

The process can be used for both solid injection moulded plastics parts and structural foam plastics components, made from ABS, polycarbonate, polypheylene oxide, polystyrene and many other polymers. A final coating of electroless nickel protects against corrosion, abrasion and provides a suitable base for cosmetic finishing.

Elastomeric gaskets

Dowty Seals [6] claims to have achieved a breakthrough in EMI/RFI screening with its new Dowshield range of conductive elastomeric seals and gaskets. This range incorporates seven different compounds and three types of seals — Dowprint, moulded seals and extruded profiles.

Four of the compounds are used specifically for the production of flat elastomeric gaskets by the company's Dowprint screen printing process. For this, there is a choice of silicon or cross-linked vinyl polymers, loaded with conductive silver or silver-plated nickel particles. They provide a volume resistivity as low as 0.0004 Ω/cm and a signal attenuation as high as 106 dB by the American Society for Testing Materials (ASTM) test method.

The moulded seals and extruded components employ silicon or fluoro-silicon materials loaded with silver-plated nickel.

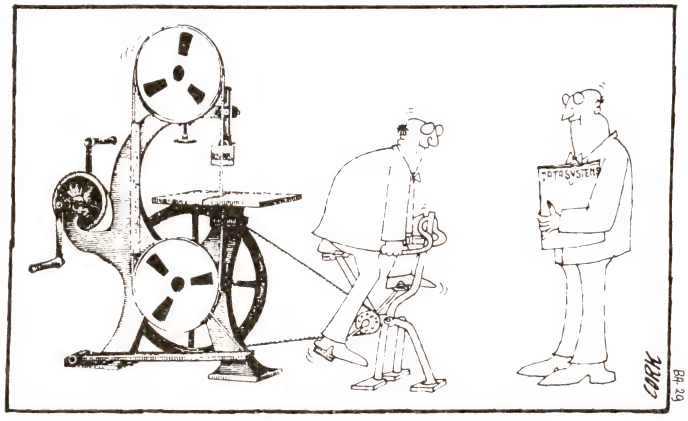
Radiation dosemeter

Another interesting innovation on the plastics front is the development of 20% and 30% glass fibre-reinforced, nuclear radiation resistant, polyethersulphone — Victrex PES — by ICI[7].

The British custom-moulding company, Jarzon Plastics[8] has added these materials to its range of engineering plastics. It has collaborated with the GEC company to design and produce nuclear radiation dosemeters — worn on the wrist — in one of these materials, which allows gamma rays to penetrate. After exposure to radiation, the dosemeters are slotted into a drawer of the same material, which in turn is slotted into a reader to obtain the radiation level readout.

References:

1. Basic Volume Ltd, 13a Cotswold Street, London SE27.
2. Harwell Laboratory, Harwell, Didcot, Oxfordshire OX11 0RA.
3. Cray Advanced Materials Ltd, 6 Armoury Road, Lufton Trading Estate, Yeovil, Somerset BA22 8RL.
4. Ceramic Developments (Midlands) Ltd, St Marks Road, St James Industrial Estate, Corby, Northamptonshire NN18 8AN.
5. Shipley Europe Ltd, Herald Way, Coventry CB3 2RQ.
6. Dowty Seals Ltd, Ashchurch, Tewkesbury, Gloucestershire GL20 8JS.
7. Imperial Chemical Industries PLC, Petrochemicals & Plastics Division, PO Box 6, Bessemer Road, Welwyn Garden City, Hertfordshire AL7 1HD.
8. Jarzon Plastics Ltd, Golden Crescent, Hayes, Middlesex UB3 1AQ.



NEW RE-DESIGNED VIFA SPEAKER KITS FOR 1988

Call into any one of our showrooms for an audition (not Concord)

SA-50 Unbelievable sound from such small speakers. Measures only 26(H) x 17(W) x 195(D)cm. Incorporates a 5" woofer and D19 dome tweeter. See AEM magazine for a full review, May edition. Complete kit with cabinets only:

$399

SA-70

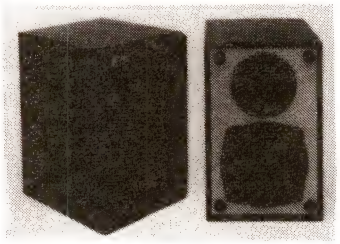
$499

SA-100

$799

SA-130

$1199

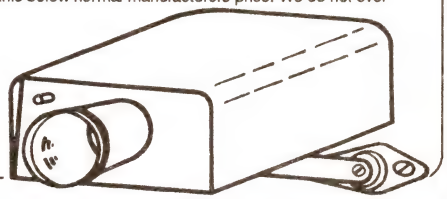


See our catalogue for full details.

DUMMY CAMERA BARGAIN

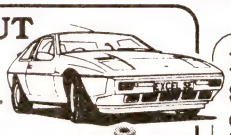
We all know that shoplifting and vanalism cost a small fortune very year. It has been demonstrated that television surveillance cameras in the right environment can discourage this activity.
This is where you come in.
We have made a great purchase of realistic-looking Dummy TV Cameras. They are Australian made, are supplied with adjustable swivel mounting bracket, fixing screws, flashing LED circuit board and 2 flashing LEDs. One red LED is mounted in a bezel on the front of the camera to add reality and the other - would you believe - is mounted BEHIND the dummy cameras lens! It looks really corny when it flashes and you COULD disconnect that LED but if a thief was ignorant of the cameras operation it may make the camera look more realistic to him. Also supplied is the 2 x D cell nylon battery holder to power the flasher circuit. A fake cable wallplate is also supplied as well as a very conspicuous 210(W) x 160(H) self adhesive sign which says "THESE PREMISES ARE PROTECTED BY TIME-LAPSE ANTI-THEFT CAMERAS" The text of the sign is in orange-red fluorescent ink against a black background.
BUT HURRY! We have around 300 of the cameras at this below normal manufacturers price. We do not ever expect to be offered similiar stock again.
Cat. LC-5310

1 - 4 pieces	$49.95
5 - 9 pieces	$42.95
10 - 19 pieces	$39.95
20+ pieces	$37.95 each



1988 JAYCAR ENGINEERING CATALOGUE
Have you got your copy yet? It has 132 pages and over 4000 products for the electronics enthusiast and professional. Two easy ways to get yours: (1) Call into any Jaycar store. Only $1 (2) Send $2 to PO Box 185 Concord 2137 and we will send you one.

FUEL CUTOUT SOLENOID



Who needs a noisy car alarm, after you have installed one of these in your vehicle. It's operated from a hidden switch. Simply turn it on when you leave your car, and if your car is stolen, it won't go very far without any petrol. Supplied with instructions, pre-wired switched, hardware and even two alarm stickers. Quality M&D Alarm brand. Add to this our deluxe red light flasher kit - KJ-7000 $19.95, and who needs an alarm?
Cat. XC-2050

$69.95

DISCOUNTED KITS AT CLEAROUT PRICES SAVE $$$$$$$$$$

Cat	Description	Mag	WAS	NOW
KA-1687	Electronic Rain Guage	EA March 87	$49.95	$29.95
KA-1688	Electronic Stroboscope	EA Aug 87	$13.95	$6.95
KA-1689	Experimenters Power Supply	EA Sept 87	$26.95	$14.95
KA-1678	Electric Fence - Hi Power	EA Oct 86	$229.00	$129.00
KE-4728	Phone Ring Tone Customiser	ETI June 87	$29.95	$20.00
KE-4715/6	Intelligent Modem Kit with Power Supply	ETI 85/6	$428.00	$249.00

LOWER PRICES ON HITACHI MOSFETS FOR 60000 AMP

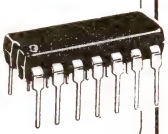
	WAS	NOW	CAT
2SJ56	22.95	14.95	ZT-2450
2SK134	19.50	13.95	ZT-2455

DIRT CHEAP!!

74HC SERIES FROM JAYCAR

74HC00	$0.75	Cat. ZC-4800
74HC02	$0.75	Cat. ZC-4802
74HC04	$0.75	Cat. ZC-4804
74HC11	$0.75	Cat. ZC-4820
74HC139	$1.25	Cat. ZC-4850
74HC368	$2.95	Cat. ZC-4870
74HC373	$2.95	Cat. ZC-4874
74HC393	$2.95	Cat. ZC-4880
74HC4075	$0.95	Cat. ZC-4896

We have available a small range of HC series LS for a limited period.



MULTIMODEM II SALE

WAS $349
JUNE SPECIAL
ONLY $249
SAVE $100
Cat. XC-4822

AVTEK MULTICOM
SAVE $50
ONLY $99.50
Cat. XC-4840

BASIC CIRCUITS

Featuring more than 300 worked examples and 900 practice problems. Electric Circuits is written for electrical/electronics students in colleges and technical institutes. The text covers electricity and the structure of matter, basic and complex circuits and vectors, DC and AC measurements, complex networks, and much more. Practice problems include schematic diagrams and emphasising alternate solutions.
Hard cover - size 260mm x 180mm - 888 pages
Cat. BH-0904

NEW '88

$69.95

Active Filter Design

This comprehensive text provides both students and engineers with a clear understanding of the hows and whys of active filter design.
Soft cover. Size 225 x 150mm.
133 pages
Cat. BH-0900 **$22.95**

NEW LITHIUM BATTERY

No. CRD 2325
As used in IBM and other computer clocks.
3 volt.
Cat. SB-2530

$7.95

DIAL DRUM/CORD PACK BARGAIN

This will probably be your first and last chance to ever buy assorted dial drums. As used in the old day tuners, they are ideal for the hobbyist who likes experimenting. This pack contains $37.75 worth of dial drums and dial cord and you can have one for only $5. You will not see dial drums again - especially at this clearout, once in a lifetime price. Your junkbox needs some dial drums for the future.

WHAT YOU GET

	Value
108mm dial drums x 2	$5.50
54mm dial drums x 10	$15.00
57mm dial drums x 2	$3.00
40mm dial drums x 10	$12.50
2.5 metres dial cord	$1.75
	$37.75

ALL FOR ONLY $5.00
Cat. HM-3130

DIRT CHEAP!!

DON'T MISS OUT
LAST CHANCE - EVER

MORE NEW SPEAKERS

MIDRANGE

Quality 5" sealed back midrange with large magnet. Made in NZ.

Power Handling	System 100 watts rms
Freq. Response	350 - 7.5kHz
Resonant Freq.	400Hz
Sensitivity	90dB/1W - 1 met
Impedance	8 ohm

Cat. CM-2078

$19.95

MIDRANGE

Same as CM-2078 speaker except that it has a metal surround.
Cat. CM-2079

$24.50

5" WOOFER/MIDRANGE

High quality NZ made speaker with large magnet.

Power Handling	20 watts rms
Freq. Response	80 - 15kHz
Resonant Freq.	80Hz
Sensivity	90dB

Cat. CW-2104

$18.95

IBM PC & PC XT USERS REFERENCE MANUAL Second Edition

Expanded to include the features of the more powerful PC XT, this revised edition contains the most up-to-date information available on the IBM PC. From system setup through using DOS and programming techniques, this book provides users with clear, step-by-step explanations of IBM PC hardware and software - complete with numerous illustrations and examples.
Includes: • comparisons between the PC and XT • using DOS 3.1 • upgrading your PC to an XT • information on the customised hardware configurations of the PC and XT • explanations on how to load programs on a fixed disk and how to organise directories.
Soft cover - size 235mm x 180mm - 479 pages
Cat. BH-0902 **$45**

CASTORS

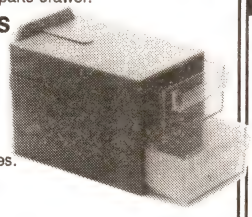
Another scoop surplus stock buy. Set of 4 castors to suit speaker boxes, TV's or anything for that matter. Castors are mounted on a 37mm square metal bracket which is simply screwed to the speaker box etc. by 4 self tappers. (Screws not supplied)
Originally used on colour TVs.
Cat. HP-0838

SET OF FOUR
$5.00

NEW FROM JAYCAR - AUSTRALIAN MADE UTILITY BOXES

Jaycar are proud to announce a new range of Australian made storage cases, one of which will actually replace an imported parts drawer.

Interlocking Parts Drawers



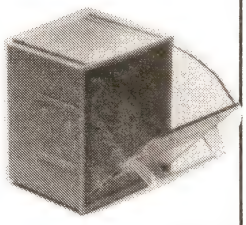
A two drawer case, with 3 removable plastic insert boxes in the lower drawer. These are ideal to remove from drawer to find that nut or resistor, without taking out the complete drawer. Side and top/bottom keying system allows you to use just a few, or build a whole wall of drawers as your parts expansion dictates. Flange on the rear of the case has two screw holes for easy mounting. Slide handles also takes identity cards, which are supplied.
Size 137(D) x 97(H) x 85(H)mm. Beige colour.
Cat. HB-6305

$5.95

10 up $5.50 ea

NEW'88

Component Drawer



Large see through drawer which has fall forward opening action, rather than usual drawer action. Interlocking both vertical and horizontal, can be fastened to wall, beige in colour. Unlimited uses.
Removable compartments for easy cleaning.
Size 11(H) x 103(W) x 83(D)mm.
Cat. HB-6308

$5.95

10 up $5.50 ea

Utility Box

Ideal system for the serviceman, or mobile workshop, or just to keep all those resistors and capacitors tidy. Also ideal for fishing tackle boxes and many other uses. Six of these utility boxes will fit snugly into the carry case pictured.
Size of utility box 188 x 115 x 36mm. Colour opaque white.
Cat. HB-6310

$2.29

10 up $2.10 ea

Utility Carry Case

Specifically designed to hold 6 utility boxes snugly to give a 30 compartment totally portable parts storage system.
Size 365 x 210 x 80mm. Colour white.
Cat. HB-6312

$17.95

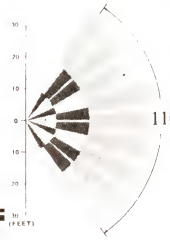
SPECIAL INTRODUCTORY OFFER
6 - UTILITY BOXES AND A CARRY CASE FOR ONLY $28.95 - SAVE $2.74.

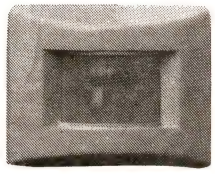
PASSIVE INFRARED DETECTOR PRICE BREAKTHROUGH PULSE COUNT PIR FOR UNDER $100

NEW'88

It had to happen, and Jaycar is the first to offer you a quality PIR with pulse count for under $100. Jaycar was the first to offer pulse count PIRs way back in February 1987. Since then we've sold thousands! Pulse count virtually eliminates false alarms.
Here's how it works.
The circuit first senses an alarm (pulse 1) and then goes into alarm standby mode for 30 seconds duration. If during the 30 seconds standby mode a second alarm event occurs (pulse 2), the detector goes immediately into alarm, and the standby period will be extended for another 30 seconds. If there is no second alarm pusle during the 30 seconds standby mode the detector returns to normal condition.
Features:
- Coverage 12 metre x 12 metre
- Detection angle 110°
- Detection beamss - 38
- Adjustable angle
- Tamper proof protected
- N/C and N/O output

Cat. LA-5017



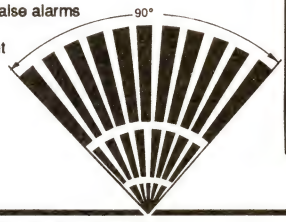


ONLY $99.95

TERMINATOR PIR WITH PULSE COUNT

Jaycar are proud to announce a new PIR to our range.
The Terminator has features found in those really expensive PIRs.
FEATURES
- Pulse count which virtually eliminates false alarms
- 48 detection beams in 3 ranges
- Sliding PC board for pattern adjustment
- Optional lens for use in hallways
- Tamper proof protected
- Plus all the usual features of PIRs.

Cat. LA-5018



$119.00

Halway Lens Cat. LA-5020
$3.95

8" TWINCONE SPEAKER BARGAIN

We have made another speaker scoop purchase. This time from New Zealand of all places. These are made in NZ and are very high quality. There is one small catch although, they are 4 ohm.

10 WATT	20 WATT
$8.95	$13.95
10 up $8	10 up $12.95
Cat. CE-2322	Cat. CE-2323

DIRT CHEAP!!

TURN YOUR SURPLUS STOCK INTO CASH!!
Jaycar will purchase your surplus stocks of components and equipment. We are continually on the lookout for sources of prime quality merchandise.
CALL GARY JOHNSTON OR BRUCE ROUTLEY NOW ON (02) 747 2022

DON'T JUST SIT THERE - BUILD SOMETHING!!!

MADE IN AUSTRALIA

TRANSISTOR IGNITION

Refer Silicon Chip May '88
A high energy ignition system which uses the cars existing ignition coil and points, with extended dwell and compatible with our Hall Effect and Opto ignitions. Complete kit with PCB, diecast box and all components.
Cat. KC-5030 **$49.95**

ACTIVE CROSSOVER

Refer ETI June '88
Short form kit includes PC board and all on board components.
Transformer is extra Cat. MP-1012 $19.95
Cat. KE-4733 **$39.95**

JUNE KITS

240 VOLT LINE FILTER

Refer EA June '88
Kit includes box, 240V socket and plug, PCB and all components and hardware.
Cat. KA-1703 **$39.95**

NEW'88

FM RECEIVER

Refer EA June '88
Kit includes PCB, box, front panel, planetary reduction drive, TDA7000 chip and all components.
Cat. KA-1704 **$55.00**

Jaycar ELECTRONICS

HEAD OFFICE
115 Parramatta Road Concord 2137
Telephone (02) 747 2022
Telex 72293
FACSIMILE (02) 744 0767

MAIL ORDERS
P.O. Box 185 Concord 2137
HOTLINE (02) 747 1888
FOR ORDERS ONLY
TOLLFREE (008) 022 888

POST & PACKING

$5	$9.99	$ 2.00
$10	$24.99	$ 3.75
$25	$49.99	$ 4.50
$50	$99.99	$ 6.50
OVER $100		$10.00

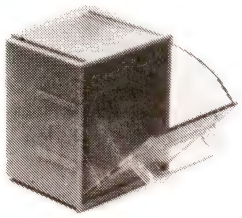
MAIL ORDER VIA YOUR ☎ ROAD FREIGHT ANYWHERE IN AUSTRALIA $13.50

AMERICAN EXPRESS · VISA · bankcard · MasterCard

SYDNEY - CITY	117 York St. (02) 267 1614 - Mon-Fri 8.30 - 5.30 Thurs 8.30 pm - Sat 9 - 12	
CARLINGFORD	Cnr. Carlingford & Pennant Hills Rd (02) 872 4444 - Mon-Fri 9 - 5.30 Thurs 8.30 pm - Sat 9 - 2pm	
CONCORD	115 Parramatta Rd (02) 745 3077 - Mon-Fri 8.30 - 5.30 - Sat 8.30 - 12	
HURSTVILLE	121 Forest Rd (02) 570 7000 - Mon-Fri 9 - 5.30 Thurs 8.30 pm - Sat 9 - 12	
GORE HILL	188 Pacific Hwy cnr Bellevue Ave (02) 439 4799 - Mon-Fri 9 - 5.30 Sat 9 - 4pm	
BURANDA QLD	144 Logan Rd (07) 393 0777 - Mon-Fri 9 - 5.30 Thurs 8.30 - Sat 9 - 12	
MELBOURNE-CITY	Shop 2, 45 A'Beckett St City (03) 663 2030 Mon-Fri 9 - 5.30 Fri 8.30 - Sat 9 - 12	
SPRINGVALE VIC	887-889 Springvale Road Mulgrave (03) 547 1022 Nr Cnr. Dandenong Road Mon-Fri 9 - 5.30 Fri 8.30 - Sat 9 - 12	

Australian utility boxes drop their drawers!

Jaycar Electronics has released a range of new utility boxes, including two models with see-through plastic drawers, one of which opens with a unique "fall-forward" action.



The conventional two-drawer box, which retails for $5.95, has three removable plastic insert boxes, which make it extra easy to remove that last elusive nut or diode, particularly if you're blessed with thick fingers.

The "fall-forward" component drawer is also $5.95, and can be stacked vertically or horizontally to provide very efficient and convenient storage for the technician or hobbyist. The drawers are designed to be attached to the wall, saving that precious bench space.

Another alternative is the utility carry case, priced at $17.95, which is designed to hold six separate utility boxes, which retail for $2.29 each. This system provides 30 separate compartments in a completely portable package – just the shot for servicemen or even for organising fishing tackle and paraphernalia. Jaycar offer this case with all six boxes for a total of $28.95 – saving $2.74 off the individual prices.

Switched-capacitor filter chips

For those following Jack Middlehurst's series on Practical Filter Design, the special National MF-series switched-capacitor IC filter chips featured in this month's episode are obtainable from Geoff Wood Electronics.

A veritable "Aladdin's Cave" of electronic delights, particular semiconductors, it should come as no surprise that these chips are available from Geoff Wood.

Costing but a few dollars, and using minimal external components, you can experiment for hours – weeks – at minimal cost. Fly on over to Lane Cove, for your National MF filter chips, **229 Burns Bay Road, Lane Cove West 2066 NSW. (02)427 1676.**

Multipurpose repair kit

Everyone who works with electronics needs a basic set of tools, and most of us find it convenient to have more than one set – one for the workshop, one for the car, and one to replace all the lost bits!

Dick Smith Electronics have come up with a 68 piece multipurpose repair kit particularly well suited to the car tool kit.

The set includes an auto electrical checker, heavy duty pliers, crimp terminal pliers with 60 assorted lugs, insulating tape, hook-up wire and more.

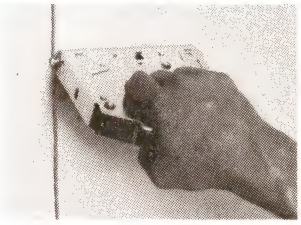
At $24.95, the set costs less than a tankful of petrol.

Quick cable clip fixing

Have you ever misjudged a blow with a hammer while fixing cables to a wall, and squashed the cable flat? The new Bowmaster-Clipson Clip gun eliminates this and many other clip-fixing catastrophes, the makers say.

The clip-gun is similar to a stapling gun, and uses impact-resistant plastic clips with pre-positioned tacks in magazines of twenty clips. Three clip sizes are available.

Apart from preventing damage from hammer blows, the clip- gun also greatly facilitates the fixing of clips in difficult to access areas, such as tight corners. The strike can be repeated if necessary, for example in fixing to very hard wood.



The Bowmaster-Clipson Clip Gun is available from GEC Electrical Wholesale outlets and other Bowthorpe stockists.

Experimenter bargains in car electronics

Just arrived at Eagle Electronics in Adelaide as we go to press is a truckload of car computers, cruise controls, alarms, and what all US manufacturer, Zemco.

They have boxes of fuel sensors, speed sensors, command modules, displays – you name it! All ideal for the experimenter, especially the much sought-after sensors.

Write, phone or call in. Tell 'em what you need and they'll see if they can help. Ask for Peter. Say you saw it in AEM. **Eagle Electronics, 54 Unley Rd, Unley 5061 S.A. (08)271 2885.**

PROJECT BUYERS GUIDE

Our novel **AEM1503 Tilt Alarm** project should find application in every "electronics" home! A kit for this project will be stocked by Dick Smith Electronics stores and components are widely available from almost any electronics retailer, so constructors will have no difficulty sourcing requirements.

The **AEM4624 Superbis Modem** is available from Maestro Distributors on special offer – see the advertisement elsewhere in the magazine.

This month's Star Project, the **Four-input Mini Mixer** is available through Dick Smith Electronics stores and dealers, or by mail order through PO Box 321 North Ryde 2113 NSW.

In our Elektor Section this month, the **Plotter** is an intriguing project for the ingenious enthusiast. We have published it out of interest and anyone intending to attempt construction will have to spend some effort securing parts – particularly the mechanical parts. If you have access to a machine shop, the latter should present few difficulties. For the electronics, you'll have to shop around – try Geoff Wood Electronics or Radio Spares for the semiconductors.

The **VLF Converter** should provide some intriguing listening to the RF enthusiast. Fortunately, components – or suitable substitutes – are available from Stewart Electronic Components in Melbourne (03)543 3733.

AEM 3520 RECEIVER KITS

Complete Kit With Crystal
(Please specify Desired Frequency)
$123 - 20 + $6 P & P

Additional Crystals $19 - 20 (+ $2 P & P if ordered seperatly)
The AEM3520 was designed by our Technical Director John Day
All our kits are supplied with professional grade components as specified in the design

BANKCARD , VISA , MASTERCARD WELCOME

Stewart Electronics
44 Stafford St
Huntingdale
P.O.Box 281
Oakleigh 3166
Phone (03) 543 3733
FAX (03) 543 7238

WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR C

CABLE SPECIALS

SMC Terminated Coax

Limited quantity only of high quality coax cables terminated at one end with a high quality SMC connector. Available in

RG178 - 1.25m long **$14.95**
RG174 - 1.2m long **$13.95**
RG174 - 0.7m long **$8.00**

Rainbow Cable

9 way multistrand 23x0.2 **$2.00**/ 30cm or **$5.50**/metre

Hook Up Wire

PVC	/ m	/100m
1x0.5 (low voltage)	**10c**	**$8.00**
7x0.2 (low voltage)	**15c**	**$13.00**
16x0.2 (low voltage)	**14c**	**$12.00**
24x0.2 (low voltage)	**23c**	**$19.00**
16x0.2 (250V)	**14c**	**$12.00**
24x0.2 (250V)	**23c**	**$19.00**
30x0.25 (250V)	**30c**	**$27.00**
32x0.2 (250V)	**30c**	**$27.00**
Teflon		
1x0.5	**30c**	**$28.00**
7x0.079	**65c**	**$59.00**
7x0.1	**30c**	**$28.00**
19x0.1	**40c**	**$38.00**
Wire Wrap		
Kynar 30AWG	**20c**	**$19.50**

IC Specials

LH0091CD True RMS to DC Converter

This IC provides true rms conversion with 0.5% accuracy untrimmed. With external trim a reading accuracy of 0.05% is possible. Normally $68.50. Limited quantity at **$39.95.**

LH0094CD Multi-Function Converter

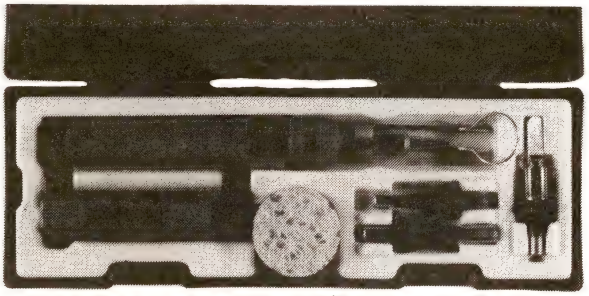
This is a high accuracy multi-function converter for precision dividers, multipliers, squarers, square roots, companders, linearization and other mathematical functions. The multiplier power is set by the ratio of two resistors. Accuracy is 0.05%. Limited quantity available at under half price. Only **$70** each

HM50256 256k DRAM 150nS **$9.10** each

64k DRAM - NS Ceramic **$5.50**

LM337H TO-5 Adjustable Negative Regulator

Output voltage adjustable from 1.2 to 47V. Handles up to 1.5A. Two resistors set the voltage. One capacitor needed for frequency compensation. Line regulation 0.01%/V typical, Load 0.3% **$4.00** each



PORTASOL PROFESSIONAL COMPLETE KIT

See E.A. April -"an extremely attractive approach..." It's a gas soldering iron... it's a blow torch...it's a hot knife...it's a hot blow. And it comes in a neat carry kit complete with a bit wiper. No cords or batteries yet it gives the equivalent of a 10 to 60W iron. You can get up to 90 minutes average continuous use from a single fill. And you refill it in seconds using a standard butane gas lighter refill. Tip temperatures as high as 400°C can be set. The kit includes one soldering tip, a hot knife, blow torch and hot blow. The cap contains a flint lighter. The complete kit comes in a handy case (with stand for the iron) which just about fits in your pocket.

Porta-Sol Professional is $81.00.

PORTASOL STANDARD SOLDERING IRON

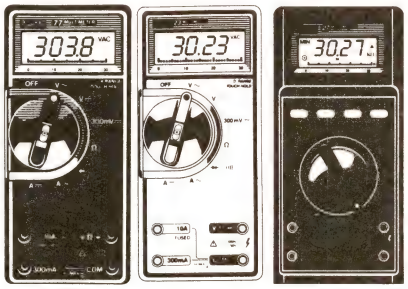
Geoff has sold hundreds of 'em to servicemen and technicians. Complete and ready to use like the Professional but you only get the iron and bit **$39.95.**

PORTASOL TIPS

Expand the capability of your Portasol Iron with spare tips -available for standard iron in 1mm, 2.4mm, 3.2mm, 4.8mm and hot knife tip. Professional tips come in same sizes plus hot blow and blow torch. Tips are not interchangeable between irons, so specify Standard or Professional when ordering. Tips are all **$12.95** each.

Fluke Multimeters

A great investment for professional users. Geoff has the 20 series and 70 series. Check the prices!!



Model 73 **$192**	***Fluke 70 Series***
Model 75 **$205**	● 3200 count display
Model 77 **$339**	● 75 adds beeper
Model 23 **$365**	● 77 adds Touch Hold
Model 25 **$545**	***Fluke 23***
Model 27 **$625**	● 10A range
	● Rugged, High energy safe
	● Touch Hold
	Fluke 25 & 27
	● Touch Hold
	● 0.1% accuracy
	● Min-Max on 27
	● Relative mode on 27

UGN3020T Hall Effect Device in TO-92 can **$1.90** each

455kHz I.F.Transformers

miniature **$1.50**

3.3µH CHOKES

Amateurs!

Not a very popular item at the normal price of $1.50 each but if you have a use for them we'll let you have em for only 50cents each if you'll buy a packet of 25 for just $12.50.

The Amazing PARTEX QWIK

WIRE STRIPPER & CRIMPER

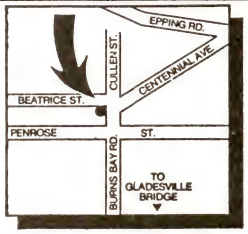
Geoff has been looking around for a really good crimp tool for stripping cables and crimping those connector lugs on. He's found it - the **US made PARTEX Qwik Stripper!**

Strips, Crimps & Cuts. Rugged steel jaw automatically adjusts for wires from 26 to 10AWG. Easy snap action with no nicking, scraping or breaking of conductors! Handles most thin jacketed multi-conductor wire too - one squeeze for the jacket, another for the conductors

Crimps solderless terminals from 10 to 22AWG and IT'S COLOUR-CODED (Red (1.5mm) Blue (2.5mm) and Yellow (6.0mm)) so you get the right pocket for each termination. Precision machined, hardened steel cutters. Comfortable insulated handles. This one is for the professional who is doing a lot of crimping and well worth **$34.95.**

GEOFF WOOD ELECTRONICS PTY LTD
229 Burns Bay Road, (Corner Beatrice St.) INC IN NSW
Lane Cove West, N.S.W. P.O. Box 671, Lane Cove N.S.W. 2066
Telephone: (02) 427 1676, Fax: (02) 428 5198.

8.30am to 5.00pm Monday to Friday, 8.30am to 12 noon Saturday.
Mail Orders add *$5.00* to cover postal charges.
Next day delivery in Sydney add $5.00.
All prices INCLUDE sales tax.
Tax exemption certificates accepted if line value exceeds $10.00.
BANKCARD, MASTERCARD, VISA, CHEQUES OR CASH CHEERFULLY ACCEPTED



SUPPORT WORLD WILDLIFE FUND AUSTRALIA

... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS

This tilt alarm will save your chairs, golf bag, bike – or whatever!

Johnathan Scott
Brereton Samuel Research Pty Ltd

What most contributes to the 'death' of a chair? Answer – the stresses occasioned by sitters swinging back on the rear legs. How do you lose a golf bag and its complement of clubs? Answer – leave it unattended. And a bike? – the same way. This simple project 'senses' when it, or the object to which it's attached, is being tilted and sets off an alarm.

FROM SCHOOLS and offices to kitchens and dining rooms, chairs are expiring at this very minute because someone is "relaxing" by tilting the chair back to the point where its centre of gravity is over the rear legs. This activity severely stresses the chair's joints where the back legs meet the seat base. After a while, the joint weakens and breaks, and the chair must be repaired or discarded. Look around, ask around – it's a widespread social "disease"!

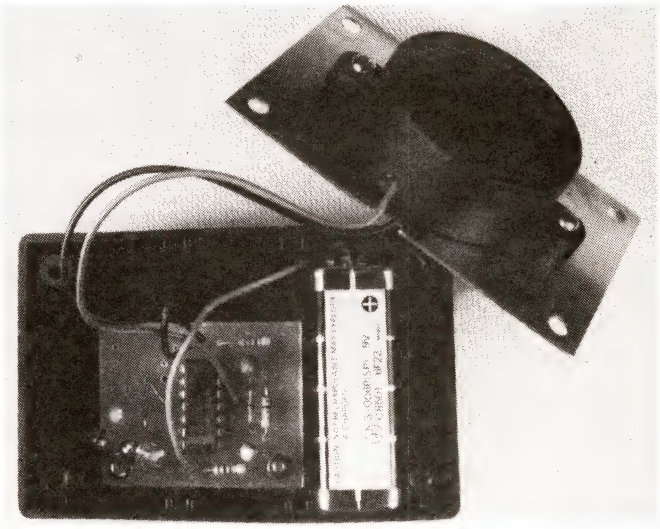
Until now, the only available course of action has been to occasionally take a swipe at the person doing it, or to get out the welder or woodworking tools to fix the poor chair, or worse, lay the miserable beast to rest and reach for your credit card and go to the furniture shop.

Now, however, there is the AEM1503 Tilt Alarm. This marvellous little wonder of modern technology will, for an investment of less than $20, mount a continual surveillance of your favourite chair, and scream blue murder when some turkey tries tilting it!

The idea is simple. It sticks to the bottom of the chair and senses the angle at which it rests. If the angle lifts 20 degrees or so from the horizontal, somebody is at it, and after a brief pause it makes a noise even louder and more revolting than a key finder. (Remember those funny things that are supposed to allow you to find your keys because they beep when you whistle, but actually serve only to disrupt peace and concentration whenever music of any fidelity is to be heard?)

At such a low price to protect a $100-300 investment, these little fellows would be pretty good value but, even better, it seems to be the case that one or two are quite enough for a whole flock (we are not sure of the collective noun for chairs, but as they seem to be about as intelligent as sheep, we adopt the term flock) of chairs. Perhaps the most hardened rocker in your family always sits in one spot around the table or prefers one chair. All you have to do is put an alarm on the chair in their regular position, and so protect the vulnerable one.

Maybe, like the device that sounds a buzzer when the bed gets wet, a few alarms can cure the habit forever. Just having a few embarrassing occasions when someone is caught harassing a chair can eradicate the rocking habit from your place. Hopefully just the knowledge that there is an alarm lurking somewhere, like some game based on Russian Roulette, will stop the rockers and protect all the chairs in the room.



The project fits neatly in the smallest available jiffy box, with the battery fitted crossways. The mercury "tilt" switch can be seen on the board at lower left.

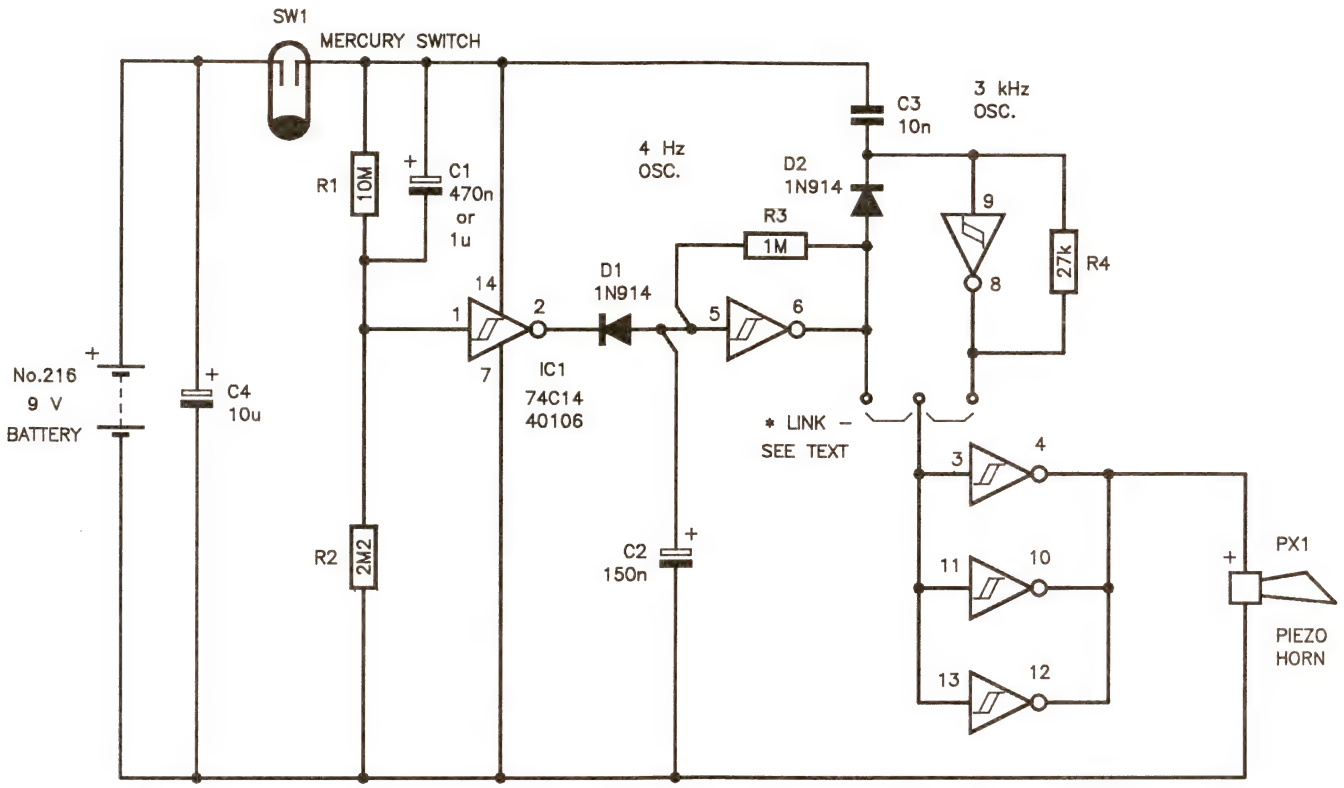
Not just chairs!

Upon demonstrating this alarm to several visitors to the AEM office, other applications were suggested – like using it to protect a golf bag left unattended for a short while (while said golfer goes to the bathroom, or somesuch). Leaving the alarm in the bag, and "armed", one then gets warning if the bag is picked up by someone other than the rightful owner. A bag and clubs can represent a pretty fearsome investment. This alarm can offer cheap insurance.

In a similar way, the alarm might be used to "protect" a bicycle. Think about it for a moment and all sorts of possibilities spring to mind (wheelbarrows. . .).

Design features

The unit is simplicity itself, and ideal as a beginner's project. It employs a single CMOS integrated circuit, a mercury "switch" as the tilt sensor, and a piezo- electric audio "alarm" unit. As the IC used is a CMOS type, it draws very lit- ▷



CIRCUIT OPERATION

The circuit is built around a single cheap CMOS hex Schmitt trigger IC with a mercury switch as the tilt sensor.

Apart from the tilt sensor, there are four separate functional sections in the circuit, namely, the delay, the pulser, the oscillator and the driver.

The delay is responsible for fixing the period of time between when the mercury switch detects a tilt and when the device starts to sound the alarm. This keeps false alarms under control, by keeping the device silent during short contacts made in moving the chair. The pulser turns the sound off and on quickly to make the sound more intrusive. The oscillator is provided so that the low cost piezo- electric beepers can be used even though they have no oscillator built in. Finally, the driver delivers the signal (either from the oscillator, or direct from the pulser if you are using a sounder with built-in oscillator) to the noise-making device.

The tilt of the chair is sensed using a switch constructed of a glass envelope with two wires and a small ball of liquid metal (mercury) inside it. When appropriately oriented, gravity pulls the ball down onto the wires, and completes the electric circuit. These switches are cheap and reliable.

There is a certain amount of hysteresis, or "backlash" in the angle sensed. This means that the switch must be tilted back by some 15 or 20 degrees before the connection made with a tilt is cancelled. Hence there will be a definite burst of sound, even if the chair is returned at once to the horizontal.

The delay between contact and the application of power to the circuit and sounding of the alarm is achieved by the circuitry associated with the first of the Schmitt triggers in IC1. The delay occurs while C1 is charged up to about⅔ of the supply. Until C1 is sufficiently charged, the output of the Schmitt trigger is held low, and via D1 the input of the second trigger is also held low.

The duration of the delay may be changed by changing the value of C1. We feel that about 1-2 seconds, set by the value we have used, is most satisfactory. As little as 100nF or as much as 10uF may be used with the time interval increasing or reducing in proportion to the value, but the capacitor should be a polyester or tantalum type for low leakage current.

While the output of the first trigger is low, the output of the second is held high, since its input is held low by D1. Once the delay is over, and the first trigger's input goes high, D1 becomes reverse biased. R3 and C2 thence form an oscillator around this second trigger.

When the output is high, the capacitor charges towards the positive rail via R3. Upon reaching⅔ of the supply, the Schmitt point for the devices in this IC, the output reverts low, and the capacitor charges towards zero volts. When it crosses⅓ of the supply the output again goes high, and the cycle repeats.

Hence the output alternately rests near full volts and ground, swapping over at about 5 Hz for the values chosen. This signal is used to pulse the noisemaker.

The same arrangement is repeated around the third trigger using D2. When freed, this third trigger also oscillates, this time at a frequency of a few kHz.

The remaining three triggers are connected in parallel, and drive the noisemaker. If the noisemaker is one with a built-in oscillator, it requires only the 5 Hz signal to be applied, and it will beep by itself. This type of sounder typically costs a few dollars and is not very small but it is quite loud.

If the noisemaker is simply the transducer, it needs the audio frequency signal to operate. This sort is typically physically smaller, costs only about one or two dollars, but is not so loud.

The correct drive for the sounder is selected by soldering a link in one of two places on the pc board.

tle power and can be readily run from a no. 216 9 V "transistor radio" battery.

The project can employ a wide range of piezo-electric noise makers. Of the two basic types, the first is simply a piezo-electric transducer by itself. These cost one or two dollars, and are usually small – about the size of a twenty cent coin. The advantages of these include size and cost, but they are not as loud as the other sort, and they need to be driven with the audio frequency you want to produce.

The second sort incorporates a small amount of electronics which accepts dc current and provides the signal to the transducer to produce a beeping signal. Because of the included electronics these are larger, and also more expensive, but the size and the specific electronic circuit make them louder.

This project will readily handle the cheaper ones, but if you happen to have one of the self-oscillating type, or can't get one of the simpler ones, or want a very loud response it will work with the other sort as well. By the simple expedient of placing a link in the appropriate position on the printed circuit board, either type of transducer can be accommodated by the circuit.

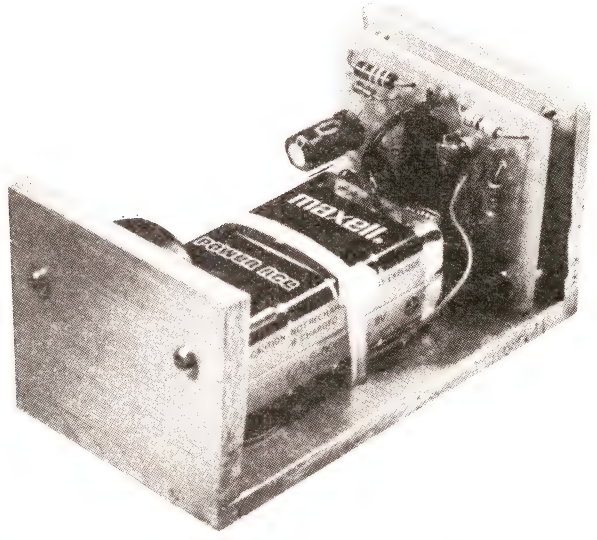
Construction

The unit may be housed in a small "jiffy" box, with the piezo alarm bolted on the lid, or on any suitable "frame", such as a piece of aluminium channel as illustrated here. Since the size (and cost) of this component will dominate the form of the project, it is best to decide which you want to use and get it first.

We built two prototypes, one in a small jiffy box using a large beeper with an inbuilt oscillator, and another in a simple aluminium bracket with a small, cheaper beeper. You can copy one of these layouts, substitute either kind of beeper, or just use our prototypes as models for your own physical layout.

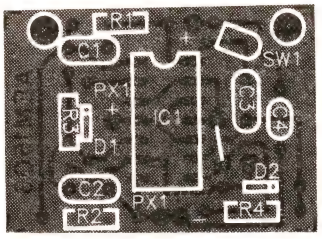
Assembling the unit is straightforward. Before commencing the electronic assembly, you should drill the box or bracket you are going to use to hold the device. Use the printed circuit board as a template to mark the positions of its mounting holes. Similarly, use the noisemaker to mark the positions of its mounting holes.

Next, solder the components to the pc board. There is no particular order, but be sure to get the orientation of the components correct. You will note that the position of the mercury switch is somewhat diagonal – its mounting holes are not quite in line. This is to assist the alignment of the switch at an angle which is suitable for detecting the tilt. The device will eventually be mounted with the pc board in a vertical position, and the mercury switch can then be moved to the correct angle. To this end, the mercury switch should not be soldered too close to the board, but should be left a few millimetres above the board surface. The rigid wires of the switch hold it in position quite satisfactorily.

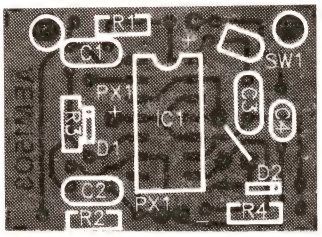


We built another tilt alarm onto a small section of aluminium channel, securing the battery with a cable tie.

LINK POSITIONS



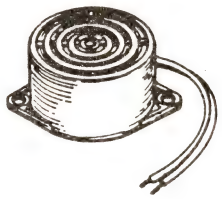
FOR SIMPLE BEEPER REQUIRING OSCILLATOR



FOR BEEPER WITH BUILT IN OSCILLATOR

The mercury switch you buy should look like this.

The commonly available small piezo transducer looks like this and requires being driven by an oscillator. Its sound output is relatively soft.



The common large piezo "beeper" looks like this and is "self-powered".

LEVEL

We expect that hobbyists who are

BEGINNERS

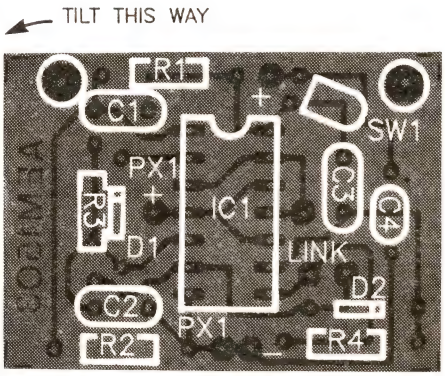
in electronics construction should be able to successfully complete this project.

Solder the battery clip and the noisemaker leads to the pc board next. It is best to check that the device works now, before you bolt it in the box.

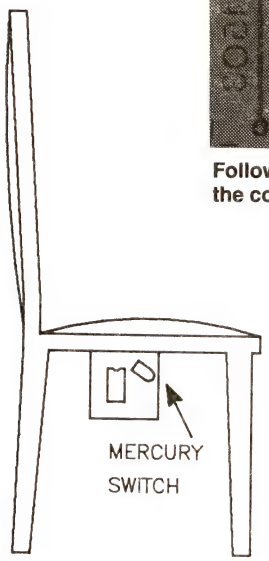
With the pc board tilted so that the mercury does not touch the contact wires, the device will be silent. When tilted so that the mercury closes the contact, there may be a tiny click from the noisemaker. After a delay of a second or so, the noisemaker will start emitting a series of sharp beeps.

Naturally, if this does not happen there is some error in the circuit. Check the pc board and the soldering for hairline cracks, "dry" joints (they look "frosty", not shiny)and so forth, particularly look for solder "bridges" between closely spaced pads around the IC. Check that the components on the board are oriented correctly, and that the battery "snap" is connected the right way round. Check also that the beeper polarity is correct, if you are using one with its own built-in electronics.

Finally, bolt the parts in the box. If you are using a larger size of box, you may have to restrain the battery with some padding, or possibly a cable tie such as we have used with the prototype mounted in the aluminium bracket. If you are using the same size small plastic case that we are using, the battery fits snugly by itself.



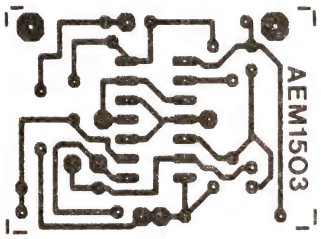
Follow this overlay diagram to assemble the components to the printed circuit board.



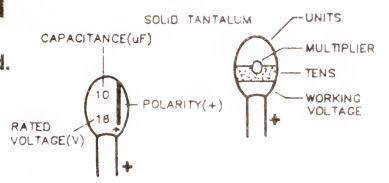
How the alarm is fitted to a chair.

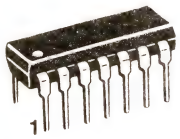
See our 'PROJECT BUYERS GUIDE' this issue for a guide to component sources and kit suppliers.

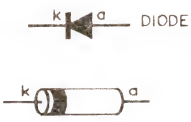
Full-size reproduction of the printed circuit artwork.



COMPONENT PINOUTS







PARTS LIST AEM 1503

Semiconductors

IC1	74C14,4014
D1	1N914
D2*	1N914

Resistors all 1/4W, 5%

R1	10M
R2	2M2
R3	1M
R4*	27k

Capacitors

C1	470n(0.47u) tant. or poly
C2	150n(0.15u) tantalum or polyester
C3*	10n polyester
C4	10u electrolytic

Miscellaneous

SW1	mercury switch
B1	pp3/216 9 V battery
PX1	piezo-electric alarm

Battery clip; pc board; mounting bracket or small Jiffy box plus associated mounting hardware; double-sided tape; battery retaining clip or cable clamp, etc.

* Needed only if using small sounder requiring audio drive.

Estimated cost:$12-$17 depending on choice of housing.

NOTE: For some applications, the alarm may be fitted with an "arming" key as follows: Mount a 3 mm jack socket on the alarm case. Connect the switched contacts of the jack socket in series with the +ve supply lead. With a 3 mm plug inserted, the alarm is OFF. Pull the plug and it's "armed".

Installation

There are two steps to setting up the tilt alarm. One is to fit it to the chair, or whatever, and the other is to adjust the tilt sensor correctly, if necessary.

As noted in the construction section, the mercury switch has mounting holes in the printed circuit board which tend to align it at about 20 degrees down from the horizontal. Every chair has a different seat angle when rocked back and this angle, while typical, may need to be changed once the chair alarm is attached.

It is perhaps better to test the angle of the switch and adjust it if necessary before finally fixing the alarm to the chair, or whatever else you're using it on.

When mounting it on a chair, the first step is to locate a suitable spot on the chair. This will usually be on the underside of the seat, preferably well out of view. Take the alarm and orient it so that the mercury switch is pointing along the front-back axis if the chair, the end without the wires tilting down about 20 degrees or so. Check that the alarm fits in the selected spot.

Hold the alarm in its intended final position, and either get someone else to rock back on the chair, or do so yourself, if you can manage both at once. Once the chair is rocked back to balance point, the alarm should go off. After it has gone off, rock the chair back until all legs touch the ground. The beeping should stop. If it didn't start, the mercury switch is tilted too far down from the horizontal; if it did not stop, the reverse is the case, and it must be tilted down further.

Make the adjustment to the tilt of the switch, removing the cover of the box in which you have built the device if necessary. The switch is easily moved through a small angle just by shoving it with your finger, bending its mounting wires a little. Repeat the above procedure until the alignment is satisfactory.

Permanent fitting of the device to the underside of the chair can be achieved in a number of ways, depending upon how you have made the alarm, and how the chair is built. In some instances wood screws may be appropriate. The easiest and recommended way is to use some double sided adhesive strip. Take a small piece, about 25 mm square, of double sided adhesive foam strip as used for sticking up posters and so forth, and stick it first to the side of the project's housing, and then to the area you have selected on the chair.

Make sure, of course, that the surface of the chair is suitably clean and flat to accept the adhesive tape.

It is just possible that you have a chair which tilts so little in getting to its equilibrium point that it is impossible to find an angle of tilt where the alarm will both go off when the chair is rocked back, and will still cancel when it is returned to the horizontal position.

The reason for this is "hysteresis" in the mercury switch. When tilted so that the mercury falls on the wires in the glass bulb, the mercury "wets" the tinned wires. Then, because of surface tension in the liquid, it is reluctant to "let go" of the wires when tilted in the opposing direction, and the switch must be tilted far enough to pull the mercury off the wires. The difference between the angle to push the mercury on to the wires, and to pull it off again is around 15 degrees.

The course of action to be taken in this situation is to set the alarm up to go off at the appropriate amount of back-tilt, and to simply accept that a small jolt will be required to turn it off after returning to the horizontal.

In fact, you might actually prefer to have this as the situation normally, by suitable alignment of the switch, because of the added embarrassment it causes since the culprit has to shake the chair after stopping rocking.

You can devise similar procedures to suit other applications.

KITS KITS KITS

8-Channel IR Remote Controller

Just think about the possibilities — remote control for your TV, CD, VCR, model railway or even mains powered appliances such as lamps, alarms, heaters, the coffee perculator... almost anything!

This unit can control up to 8 functions plus mute and up/down! What's more, it allows you to custom build the kit to suit your own specific application — construct with all functions or just those required.

Receiver Cat K-3434

$127

IR Transmitter

For use in conjunction with the IR Receiver (K-3434). Housed in sturdy plastic case with pre-punched and screened panel and 12 function buttons. Cat K-3433

$49.95

IR Remote Control Preamp

Full command over your hi-fi system **without** moving from your chair! The IR Remote Preamp comprises a complete preamp in which all functions can be selected by infrared remote control. And it's loaded with features! Plug it into your existing system via the tape monitor loop or use it with a power amp in a new system.

An incredible array of LEDs give a constant status report on the entire system. The bargraph volume display automatically indicates bass, treble, balance (up/down) while these functions are being set. Cat K-4003

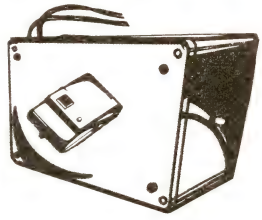
$259

Car Alarm UHF Remote Switch

The do-it-yourself way to car alarm convenience. A remote switch for your existing car alarm. Cumbersome keys are now a thing of the past with this easy to build kit idea.

The kit consist of a 304MHz receiver, decoder IC and output relay on a single PCB which is installed in a compact aluminium case.

The receiver in the DSE kit is small enough to fit on your keyring yet (unlike some other kits available) large enough to accomodate all the components easily. After installation you can remotely switch your existing car alarm from distances up to 40 metres. Kit options include momentary flasher indicator and piezo alarm or siren capability for alarm set. Cat K-3256



$89.95

Wireless Stereo Headphone Link

Enjoy high quality sound reproduction on your headphones without messy cables — with the DSE Stereo Infrared Headphone link. It saves having your ears ripped off when someone trips over the cable, allows you to listen to your favourite program while the rest of the family listens to theirs and it's ideal for anyone who's hard of hearing!

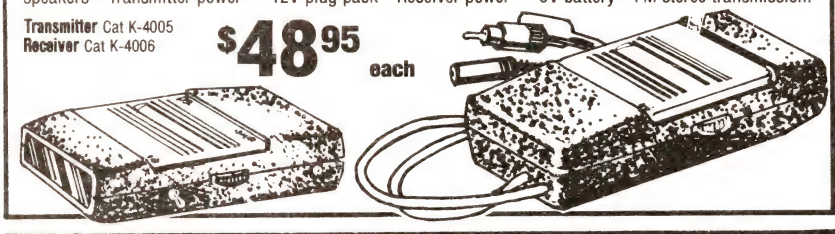
Both the Transmitter and Receiver are packaged in a compact case, which can be held in one hand, so they're not going to clutter up the table, television and benchtop. Use it on your stereo, TV... anything!

Features

• Volume control on both transmitter and receiver • Compact case — 68 × 136 × 26mm (both) • Screened aluminium front panel • Great range • Suits 32-100 ohm headphones or high efficiency speakers • Transmitter power — 12V plug pack • Receiver power — 9V battery • FM stereo transmission.

Transmitter Cat K-4005
Receiver Cat K-4006

$48.95 each



TV Colour Bar & Pattern Generator

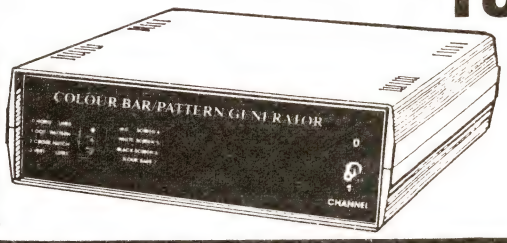
The serviceperson's right hand man!

If you're in the trade, this has to be a cinch to build!

Portable, the pattern generator is powered by a 12 volt AC plug pack and provides 8 patterns — colour bars, red/white/black screen, cross-hatch, vertical/horizontal lines and dot pattern.

Sure better value than ready made models! Cat K-3473

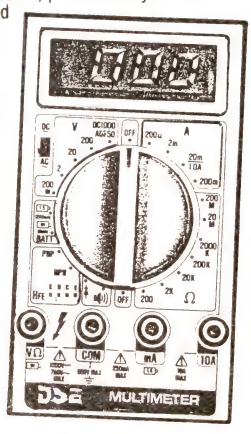
$139



WE'VE GOT THE RANGE, WE'VE GOT THE VALUE!

Safety Yellow 3.5 Digit with Tr, Diode & Continuity plus Battery Checking

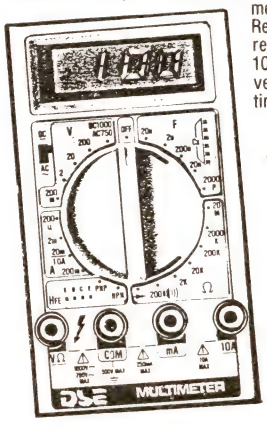
This one has all the usual ranges, including current to 10A and resistance to 200 megs, but it also has a continuity checker with a fast 100ms response time, a diode and transistor checker, plus a battery checker — it tests under actual load conditions. It takes a single 9V battery (and tells you if it's low!) and comes complete with a flip-down handle that doubles as a stand. Cat Q-1445



$79.95

Safety Yellow 3.5 Digit with Cap, Tr, Diode & Continuity

Very similar to our Q-1445 multimeter, with slightly different ranges. This one features a capacitance checker (2nF to 20uF) in place of the battery check ranges, and goes to 20 megohms as its top resistance range. Features very high overload protection (at least 500 volts DC, up to 1200V DC on most ranges), and the meter is fuse protected. Resolution is very respectable 100uV/100nA, with a very fast 300ms cycle time. Cat Q-1465



$99.50

E-Z Cable Checker

The name says it all! Every roadie, every band in the world needs one of these. Even the amateur sound recordist, club or church PA operator — anyone involved in audio cables will find the E-Z Check invaluable. Simply plug your cable in — Cannon, 6.5mm mono or stereo, RCA or BNC — and a series of LEDs tell you if it's okay. Imagine the time saving when searching for that elusive cable fault. Cat Q-1532

LAST YEAR'S PRICE $79

NOW ONLY $19.95

DICK SMITH ELECTRONICS

Build the "Mini Mixer", a low cost four-input audio mixer

Dick Smith Electronics

This four input "mini mixer" is a low cost alternative to professional units costing many times more. Providing performance which is more than adequate for the home or amateur user, it is nevertheless simple to build and use. It is particularly versatile, with a wide range of input and power supply options, and can be mounted in a case of its own, or inside your present amplifier.

PUBLIC ADDRESS SYSTEMS for bands, schools, churches and other public gatherings often require the mixing of signals from many discrete sources. For example, a number of different microphones and a tape player may be needed simultaneously during a school assembly. Most bands would like to be able to mix the output of various instruments and microphones, while still retaining control over the individual level of the devices. If you're an amateur "videographer", assembling your own video movies, this mixer is ideal for dubbing an audio track onto your final edit.

Commercial multi-channel mixers which fulfil these needs have been available since the year dot, but few can match the versatility and economy of this unit.

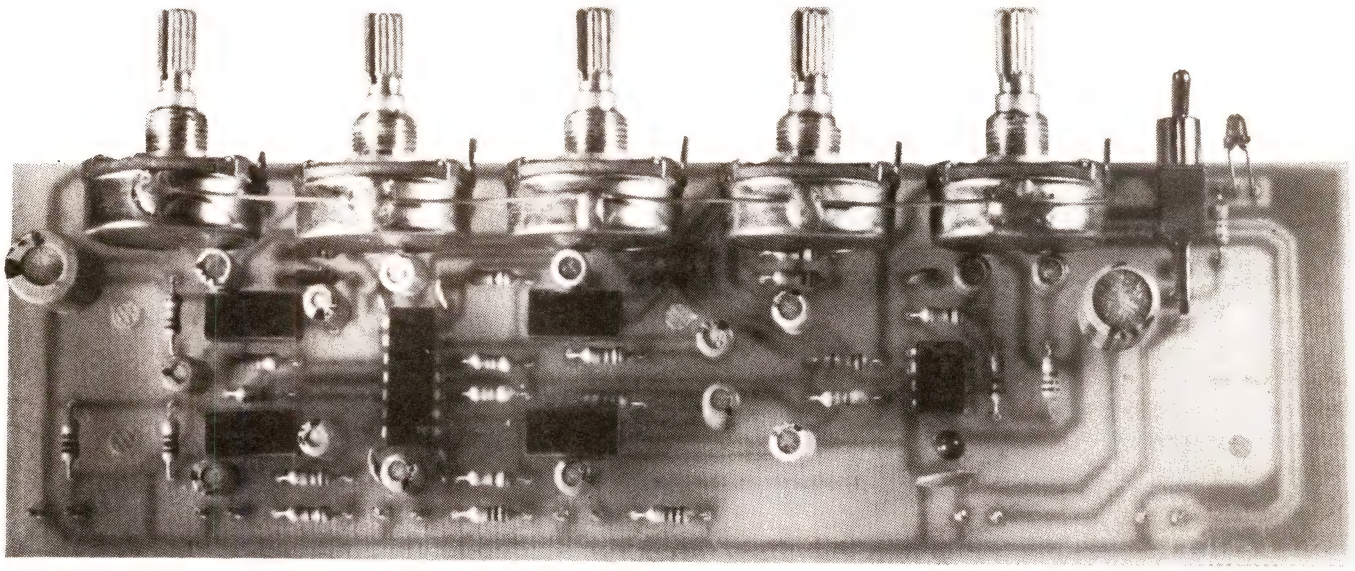
Designed with home or small-scale users in mind, the mini mixer can be used with low or high impedance microphones, or with line level signals from tuners, tape recorders, video recorders, CD players, musical instruments, film projectors, amplifiers, other mixers and similar equipment.

Four input channels are provided, each of which has a switch for the selection of either high or low impedance microphones. Four individual level controls and one master output level control are also provided.

The single pc board design with pc mounting pots and switches makes construction of the mini mixer particularly straightforward and uncomplicated. There are only two integrated circuits in the design, and the only other semiconductor is the optional "power-on" LED.

The mixer can be housed in its own box or inside an existing piece of equipment. In the latter case, the wide supply voltage limits (9-24 V single rail) and low current consumption (generally less than 20 mA) make it a simple task to ▷

This Star Project is from Dick Smith Electronics who will be marketing kits through their stores and dealers; cat. no. K-3039, $29.95. Mail order enquiries to PO Box 321, North Ryde 2113 NSW. (02)888 3200.



Top-down view of the Mini Mixer pc board. As the components are well-spaced, assembly is quite easy. While the potentiometers, switch and LED may be mounted off-board, on- board mounting is simpler. To prevent hum and noise pickup, the pot cases must be connected together via a length of tinned copper wire soldered to each and connected to the common (ground) track on the board.

SPECIFICATIONS

Inputs	4
Input Impedance	47k
Input Sensitivity: (1 V RMS out)	Low gain: 65 mV RMS High gain: 4 mV RMS
Input Overload:	Low gain: 2.0 V RMS (Vcc 9 V) 7.6 V RMS (Vcc 24 V) High gain: 125 mV RMS (Vcc 9 V) 500 mV RMS (Vcc 24 V)
Signal-to-Noise Ratio: (1 V RMS out; one channel; inputs terminated)	Low gain: better than 65 dB High gain: better than 55 dB
Frequency Response:	Low gain: –2 dB at 20 Hz –3 dB at 20 kHz High gain: –3 dB at 50 Hz –3 dB at 18 kHz
Output:	Suit line level use typically 100 mV RMS to 1 V RMS Can provide a peak-to-peak level up to 4 V below Vcc
Output Impedance:	2500 Ohms
Power Requirements:	Without LED 9.5 mA at 9 V 10.0 mA at 24 V With LED 13.0 mA at 9 V 21.0 mA at 24 V

power the mixer from the associated device, usually an amplifier or pre-amplifier. Alternatively, battery power is well suited for portable use of the mixer.

For stand-alone mounting, the board is designed to suit either of two different cases. Figure 1 gives details of the mounting arrangements for a Zippy box or the Dick Smith H-2505 Instrument Case.

In the H-2505 case, the board is held in place by two small PK screws. The front panel is drilled to suit the pot ferrules, on/off switch and LED. The pc-mount pots are self- supporting, so nuts on the front panel are not necessary.

In the Zippy box, the board slides into the pc slots moulded into the inside of the box. The front (top?) removable panel is drilled to suit the pot ferrules, switch and LED. For extra rigidity, the pots can be fixed to the panel with two nuts as shown.

In both cases, there is enough room for batteries or a small power supply, as required by the user. The spacing of the pots allows for knobs of up to 26 mm diameter.

CIRCUIT DESCRIPTION

The circuit consists of four identical input stages followed by a common amplifier section, with all sections powered by a simple voltage divider network that, effectively, provides "split" (±) supply rails for the op-amps.

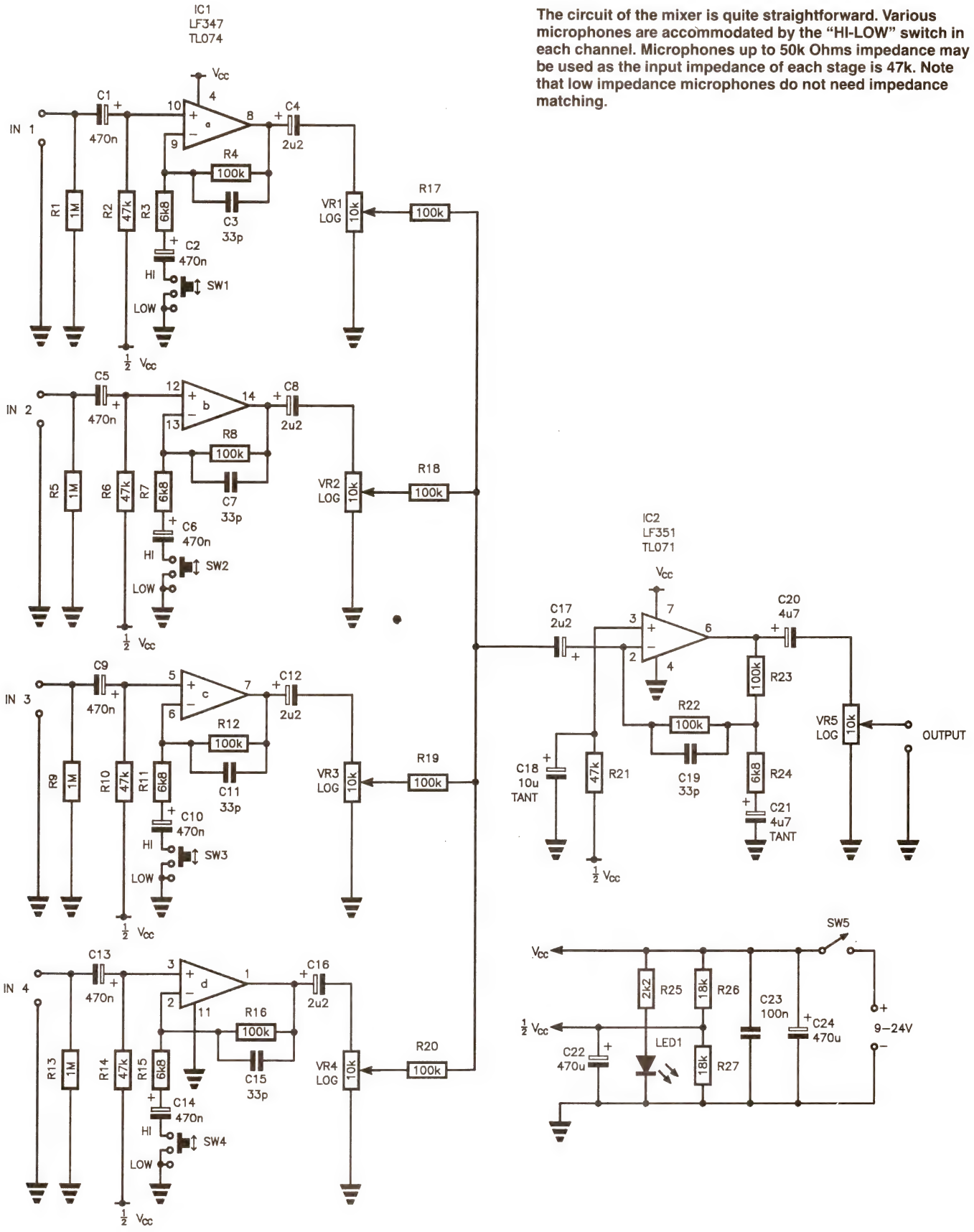
Each of the four input stages uses an op-amp from a quad FET-input package, type TL074 or LF347. The following part numbers refer to the first input section, involving IC1a. The input signal is fed into the non-inverting input, pin 10. The 100k resistor (R4) from the output back to the inverting input provides a unity gain, non-inverting stage when the gain selection switch (SW1) is in the open circuit position ('LO'). When the switch is set to HI, the amplifier provides an ac gain of around 15, fixed by the 6k8/100k resistor (R3/R4) combination. The 33 pF capacitor (C3) in the feedback loop provides gain rolloff at frequencies above the audio spectrum.

Following each input amplifier is an individual volume control for that channel (VR1). All four signals are then mixed at the virtual earth point of the inverting input of the second common amplifier, a single op-amp (TL071 or LF351). This stage provides further gain of around 15, controlled by the master output pot, VR5.

A voltage divider, consisting of R26 and R27, is adopted to cater to the dual supply needs of the op-amps. Capacitor C22 provides a bypass path for this supply. The amplifier input stages are tied to this "½ Vcc" point through a 47k resistor. As the input and output signals are referenced to the negative rail, they are dc isolated by the small electrolytic decoupling capacitors C1, C2, C4 etc.

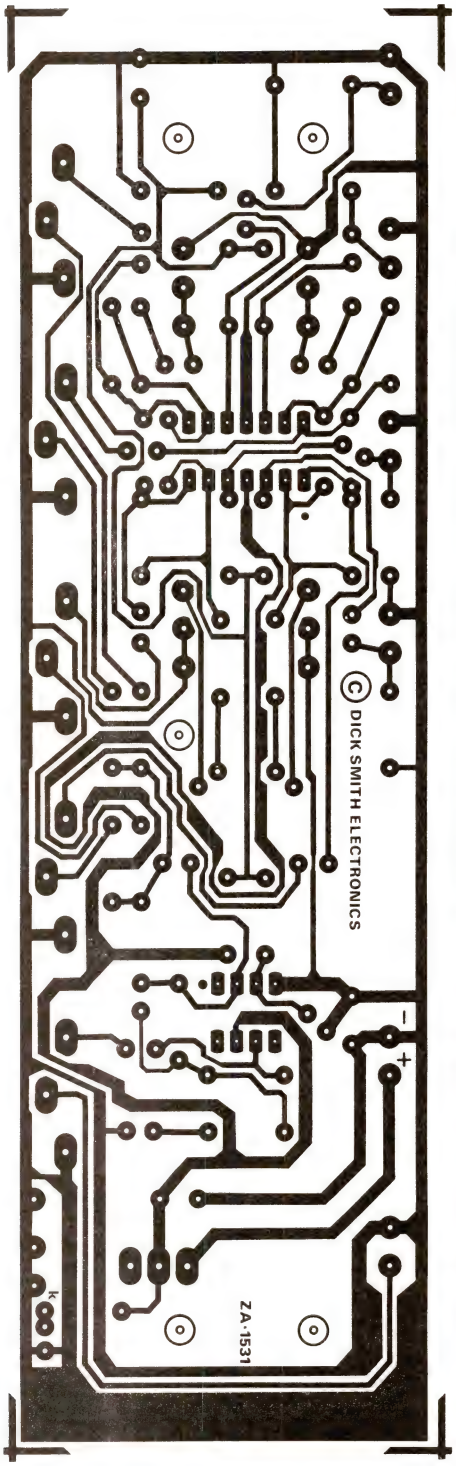
A 3 mm LED is provided as a "power-on" indicator. The value of R25 shown, which governs the LED current (and thus brightness), is suitable for the full 9-24 V supply range, but can be increased if required to reduce the current consumption at the higher end of the range. Resistor R25 could be changed to around 5k6 for operation from supplies in the 15-24 V range.

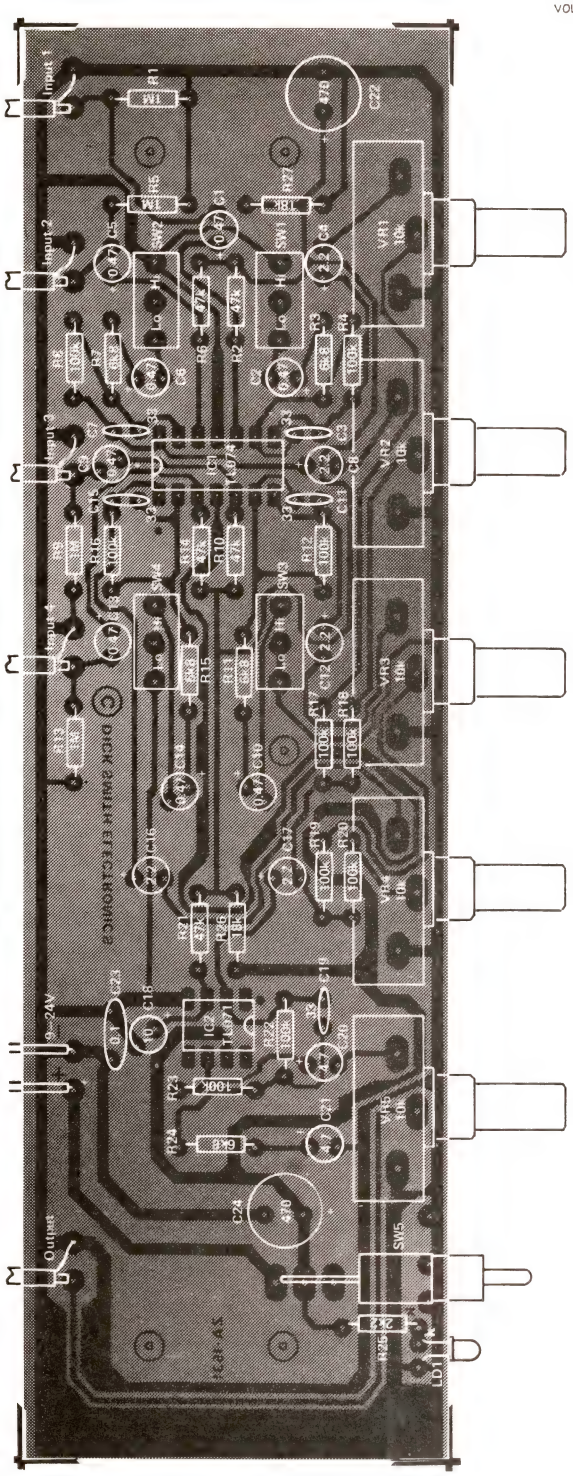
For battery operation, the LED could be eliminated to provide a little extra battery life. Alternatively, R25 could be selected to provide less illumination of the LED with consequent smaller demand on the battery. Even with the LED in circuit, many hours of use could be expected from a 216-type 9 V battery. Refer to the specifications table for current consumption figures at various supply voltages.



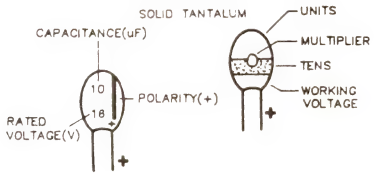
The circuit of the mixer is quite straightforward. Various microphones are accommodated by the "HI-LOW" switch in each channel. Microphones up to 50k Ohms impedance may be used as the input impedance of each stage is 47k. Note that low impedance microphones do not need impedance matching.

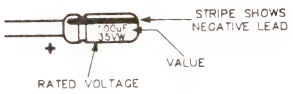
The printed circuit artwork.

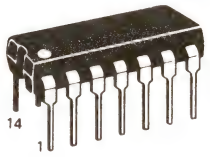


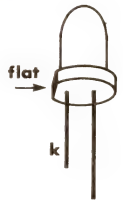


COMPONENT PINOUTS









PARTS LIST MINI MIXER

Semiconductors

IC1 . . . . . TL071, LF347
IC2 . . . . . TL074, LF351
LD1 . . . . . 3 mm red LED

Resistors all 1/4W, 5%

R1, 5, 9, 13 . . . . . 1M
R2, 6, 10, 14 . . . . . 47k
R3, 7, 11, 15 . . . . . 6k8
R4, 8, 12, 16 . . . . . 100k
R17-20 . . . . . 100k
R21 . . . . . 47k
R22, 23 . . . . . 100k
R24 . . . . . 6k8
R25 . . . . . 2k2
R26, 27 . . . . . 18k
VR1-5 . . 10k log pc mount pot.

Capacitors

C1, 2, 5, 6, 9, 10, 13, 14 . . 470n (0.47u)/50 V RB electro.
C3, 7, 11, 15 . . . . . 33p ceramic
C4, 8, 12, 16, 17 . . . . . 2u2/25 V RB electro.
C18 . 10u/25 V RB tag tantalum
C19 . . . . . 33p ceramic
C20, 21 . . 4u7/25 V RB electro.
C22 . . . . 470u/16 V RB electro.
C23 . . . . . 100n (0.1u) ceramic
C24 . . . . 470u/25 V RB electro.

Miscellaneous

SW1-4(see text) . . . . . SPST slide switch
SW5 . . . . SPDT right angle pc-mount toggle switch

ZA-1531 pc board; 12 x pc pins; 200 mm of 0.7 mm tinned copper wire; knobs to suit pots; case and accompanying hardware (see text); input and output sockets to suit application (see text); one metre of mono shielded audio cable.

Kit cost: $29.95

Construction

For ease of construction, all components except the input sockets are intended to be mounted on the single-sided pc board. Before you begin soldering, lay out all the parts and check them off against the parts list. Check the pc board for bridged or broken tracks or incompletely drilled holes.

The twelve pc pins can be inserted first. Next, insert the resistors. It is good practice to arrange all the resistors so that they are oriented the same way, i.e: with the tolerance bands towards the same end of the board. This makes future identification of the resistors much easier. When you have inserted the resistors flush with the board, slightly splay the leads on the copper track side to prevent them slipping away from the board when you turn it over. After soldering, trim the leads close to the board. Leave the pots until later.

Next install the capacitors, paying particular attention to the polarity of the electrolytics. Their orientation on the board is not consistent, and must be checked for each individual piece.

At this stage, some thought must be given to the way in which the mixer will be mounted and used. Switches 1-4 can be mounted on the board or on the front panel – depending on how often the input configuration will be changed. If they are mounted off the board, connection should be made with shielded cable. Alternatively, the switches can be dispensed with altogether to provide a permanent low impedance input, or can be replaced with wire links to provide a high impedance input.

Switch 5, the LED and the two ICs can now be inserted, taking the usual care with orientation of semiconductors. It is not necessary to solder the unused pins on IC2, the 8-pin package, as no connection is made through them and each unnecessary join increases the likelihood of short circuits or overheating.

Following usual construction practices, the five pots would normally have been mounted earlier, but in this case it is advisable to leave them until the other components are mounted. Their size and position on the board hampers access to some components if they are installed too early.

When the pots have been soldered in place, they should be earthed with a length of tinned copper wire soldered to their cases, fed through the board and soldered to the earth rail near SW5. With a hobby knife or steel wool, scratch the cadmium plating on the pot body where the earth wire is to be attached, and use a reasonably high power soldering iron for the join. Be sure to completely remove any traces of steel wool from the board afterwards.

Connection from input and output sockets to the pc pins should be made with light duty mono shielded cable.

Before applying power, check the board carefully for bridged tracks or missed joints. A hand lens and a continuity tester or multimeter are invaluable for this operation.

Final assembly

As discussed earlier, the final assembly will depend on the choice of housing, or whether the mixer is mounted inside an existing piece of equipment. Figure 1 shows two possible stand-alone assemblies.

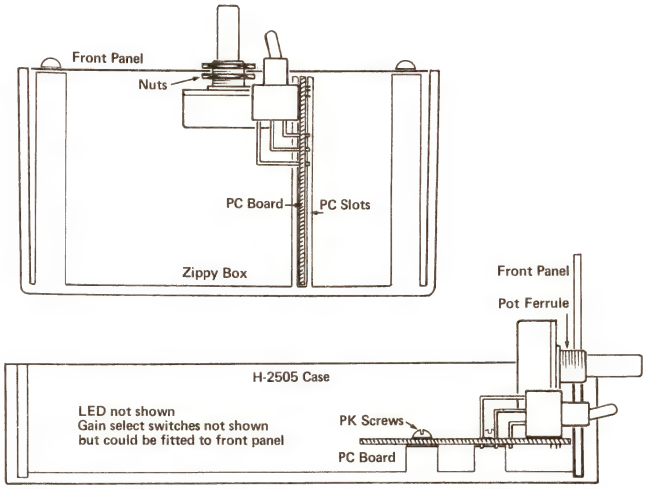


Figure 1. The mixer may be housed in several ways. At top shows how it may be mounted in a large zippy box, with the board held in place by guides on the side walls. The bottom drawing shows how it may be mounted in a H-2505 instrument case.

The control knobs for the pots tend to be a little tight the first time they are fitted, so it may be necessary to support the back of the pot while pressing them on.

There are no complicated calibrations or set-up procedures required, so the mini mixer is ready to go as soon as assembly is complete.

Check that the LED illuminates when the power switch is turned on. If it doesn't, there is most likely a short circuit between the positive and negative rails.

Connect the output to your amplifier with correctly shielded audio cables, and try each input in turn. Make sure that the operation of each input channel is identical, by checking one particular input device in each channel one-by-one. If any discrepancy is found, identify the abnormal channel and carefully examine the components associated with it on the board – particularly the shielded input connections and the polarity of the electrolytic capacitors.

If the overall operation of the mixer is abnormal, check the components associated with IC2, at the left hand end of the board. Again, pay particular attention to the polarity of the polarised capacitors, including the tag tantalum, C18.

Your mini mixer is now ready for hours of satisfying knob-twiddling!

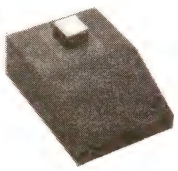
LEVEL

We expect that constructors of an

INTERMEDIATE

level, between beginners and experienced persons, should be able to successfully complete this project.

STATIC Awareness

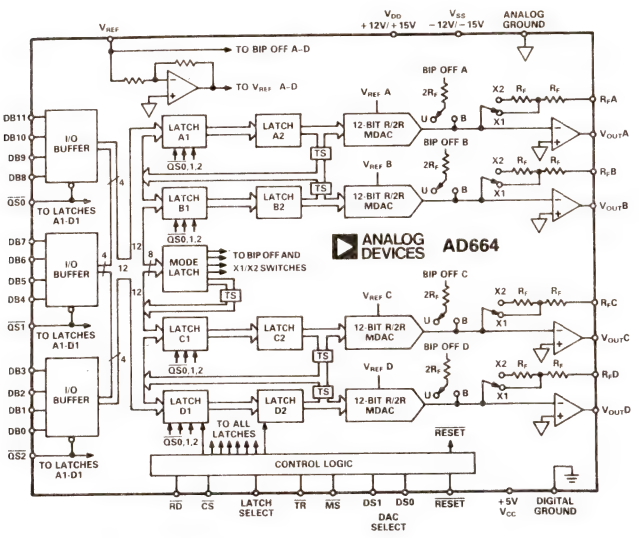


Make your personnel aware of static. Put a **Voyager PVT-300 Personal Voltage Tester** where they work.

All you do is walk up, touch the top terminal with your finger and the PVT-300 gives an instant voltage reading on its 3½ digit LED display – up to 9.99 kV.

Demonstrate personal static pickup. Check the effectiveness of grounding methods.

CLC Agencies
51 Armitree St,
Kingsgrove NSW 2208
Phone: (02)750 4005
Fax: (02)750 5224



Quad 12-bit DAC

Analog Devices has released a complete monolithic quad (four-in-a-package) 12-bit digital to analogue converter which they claim to be an industry first. It merges four 12-bit DACs on a single chip, replacing up to 15 ICs – which means a considerable area of board space can be saved in new designs employing the device.

Known as the AD644, the device is manufactured in Analog Device's proprietary BiMOS process, which combines high accuracy devices for 12-bit accuracy with dense CMOS logic.

The AD644 offers multiplying capabilities with its DACs connected to a common fixed or variable external reference voltage. All four DACs in the AD644 have guaranteed ± half LSB maximum integral non-linearity, the same differential non-linearity and ±5 LSB maximum gain error. It also features low drift, typically ±10 ppm/°C gain drift. The single-chip construction also ensures good DAC-to-DAC matching, AD claim.

External logic is eliminated with the AD644, the makers say. Double-buffered latches permit direct loading from 4-, 8-, 12-, or 16-bit data buses, and simultaneous or individual update of one or all four DACs. A bi-directional I/O buffer also adds readback capability to the AD644. A RESET command returns DAC outputs to zero, which is mandatory in process control and robotic applications. The AD644's MODE feature permits programming each DAC's output range and mode of operation.

The device operates from ±12 V, ±15 V and +5 V supplies and dissipates typically 400 mW. It comes in either a 28-pin DIP (but with restricted functions) or a 44- terminal LCC. Full details are available from the distributors, Parameters Pty Ltd, PO Box 261, North Ryde 2113 NSW.

New op-amps

Two manufacturers have announced new families of op-amps, both claiming impressive performance in different areas.

Analog Devices Inc. claim voltage drift and open loop gain specifications nearly an order of magnitude better than the industry's previous best for their new AD707C op-amp.

The AD707C is said to feature the best dc accuracy specifications available in a non-chopper-stabilised design.

Two lower priced, reduced performance grades of the AD707 are available. Low noise and offset voltage drift in these devices enable the designer to amplify very small signals without sacrificing overall system performance.

The highest grade AD707 offers a minimum open loop gain of at least 8 V/uV while input bias current is 1 nA maximum. Power supply rejection ratio (PSSR) is at least 120 dB. For all grades, the output can swing at least ±12.5 V with load resistances greater than 2 kohm (with a ±15 V power supply).

For further information on the AD707 series, contact Parameters P/L, PO Box 261, North Ryde 2113 NSW. (02)888 8777.

National Semiconductor claims an excellent speed/power product for their new family of LM6165 high-speed op-amps, an extension of the already creditably fast LM6161 series.

The LM6165 family offers the same excellent slew rate of the LM6161 (300 V/μs), and extends unity gain from 50 to 725 MHz.

These op-amps are built with National's new VIP (TM) (Vertically Integrated PNP) process as described previously in Semiconductor Scene.

For further information and full specifications contact the George Brown Group, Marketing Division, 456 Spencer St, West Melbourne 3003 Vic. (03)329 7500.

New data recovery chip

Gigabit Logic has released the 16G040 Clock and Data Recovery circuit, with wide applications in recovery of data in high speed microwave and optical fibre repeater and receiver systems.

In high speed data communications the clock signal is never transmitted explicitly, making accurate data recovery difficult. The 16G040 reconstructs this clock signal with its own internal timing network from the received data stream.

Operation from 100 MBits/sec to 2.4 GBits/sec is achievable. A demonstration board, tuneable from 100 to 800 MBits/sec is available, and has been purchased by various Australian companies and utilities for evaluation.

For further information contact Integrated Silicon Design P/L, PO Box 99, Rundle Mall 5000 SA. (08)223 5802.

Gallium Arsenide design course

Integrated Silicon Design P/L in conjunction with the Centre for Gallium Arsenide VLSI Technology, University of Adelaide, has successfully completed Australia's first training course in GaAs IC design.

The inaugural course was presented by Dr Kamran Eshraghian and Dr Donald Griffin and included in-depth analysis of GaAs technology for devices, process and design methodologies for both microwave and digital applications.

Further courses are planned with advanced courses to follow. For further information contact Integrated Silicon Design, PO Box 99, Rundle Mall 5000 SA. (08)223 5802.

Texas and Intel agree on ASICs

Texas Instruments and Intel have announced an agreement on Application Specific Integrated Circuits (ASICs), which is intended to improve design and development tasks with the establishment of a range of standards.

The agreement includes the development of a common IC cell library, a common gate array macro library, and provision for common testing, packaging and design rules.

Intended to facilitate alternative sourcing, the agreement should help avoid customer confusion and provide a high probability for successful migration.

The TI/Intel common cell library will range from SSI and

MSI (standard logic) to LSI (Peripherals, FIFOs, register files and memory compilers) and eventually to VLSI. The companies have agreed to align current CMOS processes for compatibility.

For further information contact Texas Instruments Australia Ltd, Semiconductor Group, 6-10 Talavera Road, North Ryde 2113 NSW. (02)887 1122.

A new face for Fastron

Fastron, Australia's only manufacturer of power semiconductors and semiconductor protection fuses, has updated is image with with a new logo, new catalogues and the appointment of four new distributors.

Fastron also design and manufacture electronic controllers, power diodes, thyristors, transistors, powerblocks, heatsinks and air/water cooled heat exchangers, and distribute a wide range of other electronic components.

Typical applications for Fastron power components and assemblies are in rectifiers, motor drives, battery chargers, heating, lighting and welding equipment, uninterruptable power supplies, inverters and converters.

Further details from B. Nally, National Sales Manager, (03) 584 8988.

Pipeline on a chip

Motorola's recently released 32-bit microprocessor, the 68030, features a method of processing called "pipelining", that enables it to effectively process three instructions at once (smarter than your average micro!). This feature, combined with a clock speed of 20 MHz and a few other smart features, could make really high performance desktop computers easier to come by in the near future – something the scientific and engineering communities have been waiting a long time for.

The 68030 runs the same software as its predecessor, the 68020, but is more than twice as fast. As they can be used in a UNIX environment, popular with scientists and engineers as UNIX is widely used in universities, Motorola claim that the cost of high performance computer-aided design and engineering workstations could be reduced by over one-third.

The 68030 is faster as it has on-chip memories, called "caches", for storing frequently used data and instructions. The data and instruction caches are connected in parallel with the processing section of the 68030 so that it can fetch both data and instructions at once.

DSP data book

Analog Devices, well to the fore in the digital signal processing (DSP) stakes, has released the first complete listing of all their DSP components – the "DSP Products Databook".

Included in this handy tome is information on AD's DSP microprocessors, microcoded support components, floating point ICs and fixed-point devices. A full data sheet on each IC contains all the specifications and product information to start a complete design-in.

Available from the distributors, Parameters Pty Ltd, PO Box 261, North Ryde 2113 NSW.

Extra fast recovery rectifiers

TRW Optoelectronics has just released two new series of extra fast recovery rectifiers with the fastest recovery time available, coupled with low leakage and low forward voltage, the company claims.

The hard glass sealed DSR series can be screened for equivalent devices on request. The HCR series are mounted in hermetically sealed custom surface mount leadless chip carriers, for easy handling and mounting. Both series are quoted as being suitable for medical, military or commercial applications.

For further information, contact Total Electronics, 9 Harker Street, Burwood 3125 Vic. (03) 288 4044.

EC1F11SK FORTH DEVELOPMENT SYSTEM

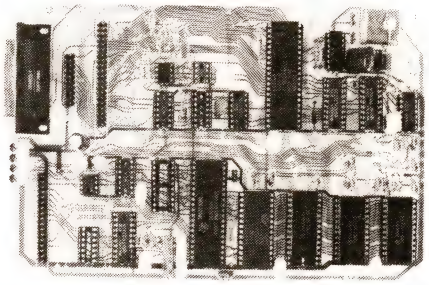
NEW YEAR SPECIAL

"FANTASTIC FORTH KIT"

$99.00 + 20% S.T. + postage

FORTH DEVELOPMENT, LEARN THE EASY WAY.

PCB PLUS PARTS LIST BIPOLAR PROM (28L22) R65FR1
MANUAL & ASSAY NOTES R65F11AP QUIP SOCKET
RSC FORTH MANUAL



energy CONTROL

Energy Control International Pty Ltd, 26 Boron St, Sumner Park Qld 4074. Phone (6107)376 2955. FAX (6107)376 3286. Telex AA43778. NZ Office: 104 Dixon St, Wellington 644858742

Practical filter design — without fears or tears

Part 9 – Switched capacitor filters

Jack Middlehurst

In this, the final part of our filter design series, we learn about the non-analogue switched capacitor filter, which distinguishes itself by providing wide variability in a simple and compact package.

SO FAR WE HAVE DEALT exclusively with analogue filters, i.e: filters in which the input and output voltages are continuous, and in which the signal voltages are continuous throughout the filter. What we will now look at is the switched capacitor filter, in which the input and output signals are continuous, but somewhere in the middle of the filter, the analogue (another name for continuous) signal is first converted to a series of pulses and then converted back to an analogue signal later in the filter. True digital filters, i.e: filters that have digital input and output and require some form of computer to enable them to work, will not be discussed in this series.

The reason for the existence of switched capacitor filters is simple. Filter engineers wanted a filter in which you could have any type of filter response and, at the same time, be able to vary the cutoff frequency by using one continuously variable control, preferably a simple potentiometer. They also wanted the whole thing to be on a single IC chip, and it would be best if it didn't need any precision capacitors. As we have already said, engineers are never satisfied.

Principles

In Figure 9.1(a) the battery "knows" that there is a resistor connected to it because it knows there is a current flowing. Now let us look at Figure 9.1(b). When the switch is connected to the left, a current will flow from the battery to charge the capacitor. If the switch is now connected to the right, the capacitor will discharge. When connected to the left again, current will flow again to charge the capacitor. If we operate the switch at the rate of one switch to and fro per second, the average amount of current that will flow depends only on the value of the capacitor and the battery voltage. The battery will "think" that the capacitor is a (slightly peculiar) resistor since there is a current flowing.

If we now operate the switch 10 times per second, the same amount of current will flow at each operation, so the average current will be 10 times larger, which will make the battery think the resistance is 10 times smaller. So we can control the apparent value of the resistance simply by controlling the switching rate.

During all of this we have assumed that the switch resistance was zero. If the switch does have a resistance, this will slow the rate at which the battery can fully charge the capacitor. In turn, this means that there will be a maximum switching frequency beyond which the current flowing will not be exactly proportional to the switching frequency.

We can now substitute a switch and capacitor for each frequency determining resistor in any active filter and control the cutoff frequency by changing the frequency of the clock that drives the switches. Since the *state variable* filter is most amenable to integration onto an IC chip and has a number of other desirable characteristics as well, this is the form of filter that was chosen to be converted to a switched capacitor design. The only difference is that non-inverting integrators are used rather than the inverting integrators of the analogue state variable filter.

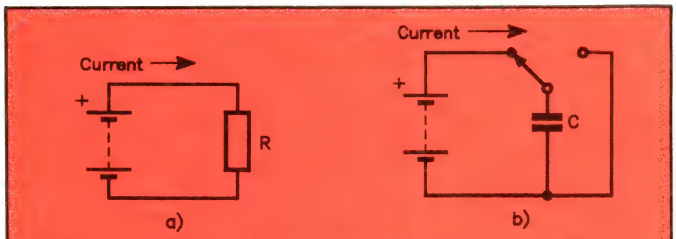


Figure 9.1. Circuits to show the way in which a switched capacitor can behave as a resistor. a) resistor b) switched capacitor.

The switches are CMOS and, to avoid complications, two switches are used at each point, one to charge the capacitor and another one to discharge it. The two switches are arranged so that they are never closed at the same time, but there is a small part of the switching cycle during which they are both open. CMOS switches have a number of advantages. They have low and reproducible on-resistances, extremely high off-resistances, negligible capacitance, do not generate significant switching voltages of their own, and a lot of them can be integrated on a small area of silicon.

A particular advantage of using the state variable filter is that the tuning frequency is proportional to 1/Rf, where Rf is the value of the resistor that sets the tuning frequency. With a switched capacitor version of a resistor, we have seen that the resistance goes down as the switching frequency goes up, in other words, 1/Rf is proportional to the switching frequency. This means that the tuning frequency of the filter is proportional to the switching frequency, which makes for a nice simple relationship. This relationship holds until the speed of the switch is so high that the resistance of the CMOS switches does not allow time for the complete charging of the capacitors. With most commercial switched capacitor filters this does not occur until the switching frequency is above about 1 MHz.

Properties of sampled data systems

The switched capacitor filter is one example of a sampled data system in which, at regular time intervals, the amplitude of the incoming signal is sampled. For the rest of the time the system has no knowledge of the incoming signal, since the system is busy doing other things such as discharging capacitors. Sampled data systems have a number of peculiar properties that we had better look at before we try and use them.

Figure 9.2 shows the way in which a sampled data system handles an incoming sinewave. The time dT is called the aperture time and the time T is the sampling time. The sampling frequency is simply 1/T samples per second and we are free to choose both the sampling frequency and the aperture time. It can be shown mathematically that a low-pass filter will reconstruct a perfect replica of the input signal if the aperture time is negligible and the sampling time is short compared to the wavelength of the incoming signal. ▷

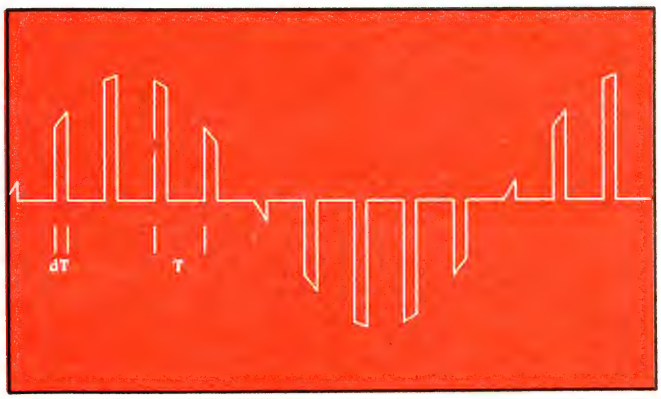


Figure 9.2. Sampling and aperture times in a sampled data system.

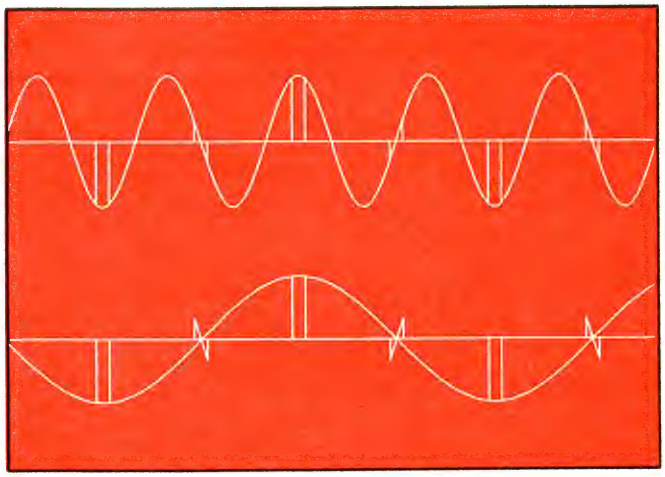


Figure 9.3. Aliasing . . . . the upper sinewave is being sampled at only 1.5 times its frequency. When the sampled data are used to reconstruct the sinewave, the frequency is wrong as the lower curve shows.

Unfortunately, since the available output signal tends to zero as the aperture time gets smaller, the signal-to-noise ratio also tends to zero. This means that, even though we have a perfect reproduction of the input signal, we can't find it under the noise. Not a particularly useful situation.

To get anything useful from the system we have to use finite aperture times and this means a less than perfect reproduction of the input signal. As we increase the aperture ratio (the ratio of the aperture time to the sampling time), the high frequency response of the filter suffers, but the magnitude of the output signal increases. This "aperture effect" as it is called can be considerably reduced by having a sampling frequency that is very much higher than the highest frequency to be passed by the filter. Most commercial filters use a sampling-to-cutoff frequency ratio of at least 10, and often 50 or more in an effort to reduce the aperture effect to negligible proportions.

Using such a high ratio of sampling-to-cutoff frequencies has another advantage. Figure 9.3 shows the effect of using a sampling frequency that is only 1.5 times the frequency being sampled. A low-pass filter will reconstruct the output signal into a sinewave alright, but the frequency is wrong. This generation of spurious frequencies by using too low a sampling frequency is called "aliasing".

Spurious frequencies will be generated by any sampled data system, but by making the sampling frequency high enough, these frequencies are kept well outside the range of frequencies being passed by the filter. If for some reason a low sampling frequency must be used, one can minimise the generation of spurious frequencies by limiting the frequency response of the incoming signal using a simple analogue LP filter. Such a filter is called an anti-aliasing prefilter.

The switched capacitor filters that we will be discussing all use sufficiently high sampling frequencies to move alias frequencies well into the ultrasonic region. If you are worried by the presence of these frequencies you can remove them with a simple RC filter after the switched capacitor filter. Such a LP filter is called an anti-aliasing postfilter. In general, prefilters are preferred to postfilters since they reduce the amplitude of the alias frequencies within the switched capacitor filter. Postfilters have the advantage that they reduce clock hash at the output, so you look at the output and decide whether you want a pre or post filter.

To reduce the area of silicon, each switched capacitor in a switched capacitor filter has a value of only a few pF. This means that they behave as quite high value resistors. This in turn means that they generate considerable amounts of thermal noise, particularly for filters having a wide bandwidth. Consequently, switched capacitor filters cannot be used for applications such as preamplifiers where the signal level is low. Indeed, their total dynamic range is rarely more than 80 dB, which is certainly not adequate for high fidelity audio applications. However, as a variable cutoff audio filter for amateur radio or communications use, or in audio systems where a compressor is used to keep the signal level high, they are ideal.

CMOS switches do, in fact, generate switching pulses in the form of small voltage spikes on the signal waveform. These are usually about 25 mV high and are referred to as *clock feedthrough*. A simple RC postfilter having a cutoff frequency of about a tenth of the clock frequency will reduce them to negligible proportions for most applications.

CMOS has one other slight disadvantage in that its offset voltage is 10 or more times that of bipolar ICs. The CMOS offset voltage depends to some extent on the type of filter, but is usually in the range 0.1 to 0.5 Vdc. This can obviously cause trouble in dc coupled systems, particularly if the following stages have dc gains greater much than 1. Consequently switched capacitor filters are to be avoided under these circumstances.

Are they worth it?

After this long list of problems you may wonder whether the whole thing is worth it. The answer is no if you want high fidelity or high gain dc coupled systems, but definitely yes if you want medium fidelity or ac coupling. They are the only way to go if you really need a filter with an easily varied cutoff frequency. For a manufacturer making a range of products incorporating filters with different cutoff frequencies, only one type of IC need be stocked and only one resistor need be changed to set the clock frequency. The savings in setup procedures and stock inventory can be considerable.

What is even more important, these filters don't need any precision capacitors. The ratio of cutoff frequency to clock frequency is controlled by the ratio of two CMOS capacitors within the IC. These ratios can be controlled to 0.1% during the CMOS process. This means that the stability of the clock controls the overall stability of the filter.

Practical considerations

Several IC manufacturers make switched capacitor filters that are available in Australia. Their products vary in the ratio of sampling frequency to cutoff frequency, clock feedthrough, offset, and signal-to-noise ratio. The rules with switched capacitor filters are ALWAYS breadboard your filter, and ALWAYS put that breadboard filter through every test you can think of before committing anything to a printed circuit board.

At the very least, test for correct filter frequency response, noise level with no input signal (including dc offset and clock feedthrough), and the maximum input or output signal ▷

before distortion sets in, over the whole frequency range of the filter. This latter is particularly important since it is possible for the filter to overload at particular frequencies within the passband.

Remember that with the state variable filter the LP output can overload and destroy the filter characteristics even though you might only be taking your output from the BP terminal or vice versa, and switched capacitor filters are basically state variable filters.

Since we can't describe each manufacturer's products, we will deal with those of National Semiconductor as being representative of what is available. This does not infer that they are better than everyone else's, simply representative.

MF series Butterworth filters

Since the large majority of filter applications in the electronics industry call for the use of an LP filter, the first switched capacitor filters were Butterworth 4th and 6th order filters. You will remember from part 2 of this series that, once you have chosen the order and cutoff frequency of a Butterworth filter, the shape of the frequency response is fixed. This considerably simplifies the filter design. The MF4 and MF6 are such Butterworth filters. They each come in two versions labelled –50 or –100. The number refers to the ratio of clock frequency to cutoff frequency. The maximum clock frequency is about 1 MHz, so for cutoff frequencies above 10 kHz you will need to use the MF4-50 or MF6-50.

These devices can be operated from a power supply of 12 Vdc (or + and –6 V) but it is good practice to restrict the power supply to 10 V (or + and –5 V) since they are, after all, CMOS. With a power supply of 10 V the available output voltage is about 2.8 Vrms. Because of the DC offset of about –0.2 V for the –50 version and –0.4 V for the –100 version, the output swing is not symmetrical about 0 V, but is approximately symmetrical about the offset voltage. If the offset is a worry, it can be trimmed to zero.

Even though these filters are basically a state variable design, only the LP terminal is made available. To make things simpler for the user there is a CMOS square wave oscillator built in that can be used as the clock. An external clock can be used if desired, but it must produce the correct CMOS voltage levels. The clock frequency is controlled with a variable resistor which becomes the cutoff frequency control.

```
10 PRINT "          Butterworth LP Filter Order ":PRINT
20 INPUT "What is the cutoff frequency [ Hz ] ? ",FC:IF FC<=0 THEN 20
30 INPUT "At what frequency [ Hz ] in the stopband is the attenuation known ? ",
F1:IF F1<=0 THEN 30
40 IF F1<FC THEN PRINT "That frequency is not in the stopband.":GOTO 30
50 INPUT "What is the attenuation [ dB ] at that frequency ? ",AMAX:IF AMAX<=3 T
HEN PRINT "The attenuation in the stopband must be greater than 3 dB.":GOTO 50
60 N=INT(LOG((10^(.1*AMAX)-1)/(10^(.3)-1))/2/LOG(F1/FC))+1
70 PRINT USING "The filter order is ##.";N:END
```

Figure 9.4. GWBASIC programme to calculate the order of Butterworth LP filters.

These filters provide the filter designer with the simplest possible design system. The GWBASIC program of Figure 9.4 can be used to determine the necessary order of the filter and, if that order is less than or equal to 4 or 6, the appropriate IC is used. The clock frequency is set at 50 (or 100) times the desired cutoff frequency and the design is finished. This is so much simpler than having to build even Sallen and Key filter blocks that it is easy to see why filter designers these days use switched capacitor filters if they possibly can. The only catch is that you have to use a 4th or 6th order filter. It is not possible to get, for example, a 10th order filter if you need it, remembering that a 4th order plus a 6th order does not make a 10th order filter.

The circuits to use with the MF4 and MF6 are given in Figure 9.5. For a ±5 V supply, the clock frequency is given approximately by Fclk = 590,000/R/C where Fclk is in Hz, R in Ohms, and C in uF. If you use values of C below about 470 pF, the frequency will be lower than you expect because of

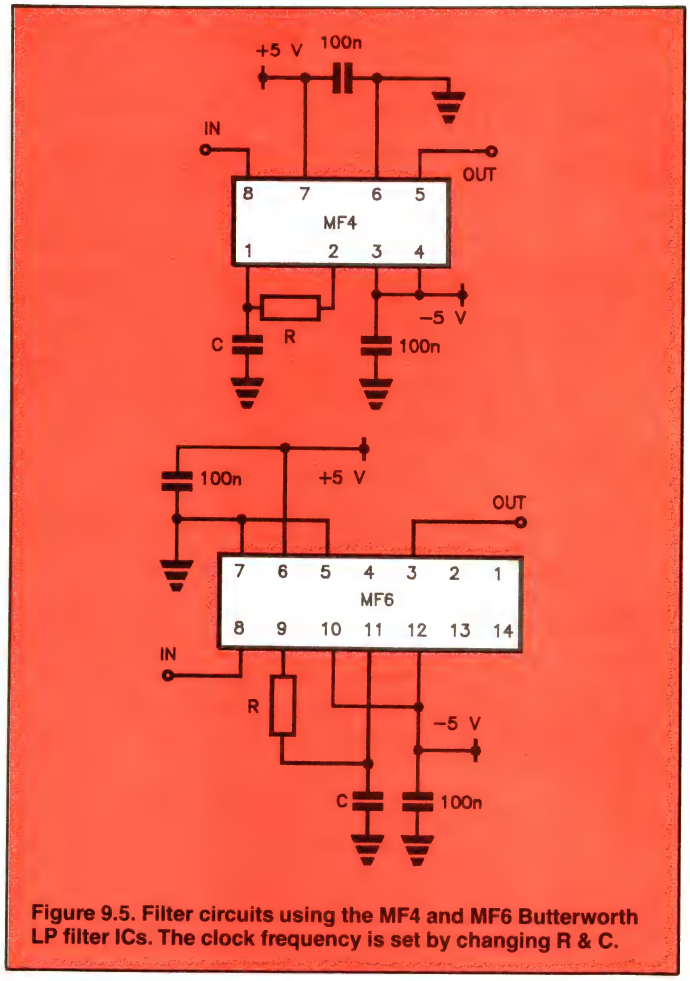


Figure 9.5. Filter circuits using the MF4 and MF6 Butterworth LP filter ICs. The clock frequency is set by changing R & C.

the stray circuit capacitances in parallel with C. This doesn't matter if you make R variable. Always put a fixed resistor of 270 Ohms in series with the variable resistor so that the total value of R cannot accidentally be reduced to zero.

The performance of these filters is only guaranteed to a clock frequency of 250 kHz, but they will work to at least 750 kHz and most of them will go to 1 MHz. As you increase the clock frequency towards the limit, the "hash" on the filter output starts to increase, then the filter output decreases, finally falling to zero. The MF6 has a spare amplifier built in; if you don't use it, it is good practice to connect pins 2 & 14 together, and to earth pin 1. This stops the amplifier picking up clock noise and amplifying it. Notice that pin 5 on the MF6 (pin 6 on the MF4) is for the signal ground and that the clock capacitor returns to this ground. The signal ground and the power supply ground should be connected together only at the power supply.

If you have an oscilloscope and examine the output waveform carefully, you will see that it is made up of a series of little steps. These steps can be taken out with a simple RC postfilter. Because they are so cheap, it is worthwhile to buy one of these filters just to experiment. If you really want a sharp cutoff "tone control", using one of these filters is the way to do it. For controlling the audio frequency response of an amateur transmitter, they are ideal. If you set the cutoff frequency of the MF6 to 3 kHz, the frequency response is down by about 35 dB by 6 kHz, which is more than adequate for most purposes. You can easily and cheaply build a variable cutoff filter and change your audio bandwidth to suit the transmission conditions at the time.

MF series general purpose filters

For those occasions where you do not wish to use 4th or 6th order Butterworth filters, the general purpose MF5 and MF10 ▷

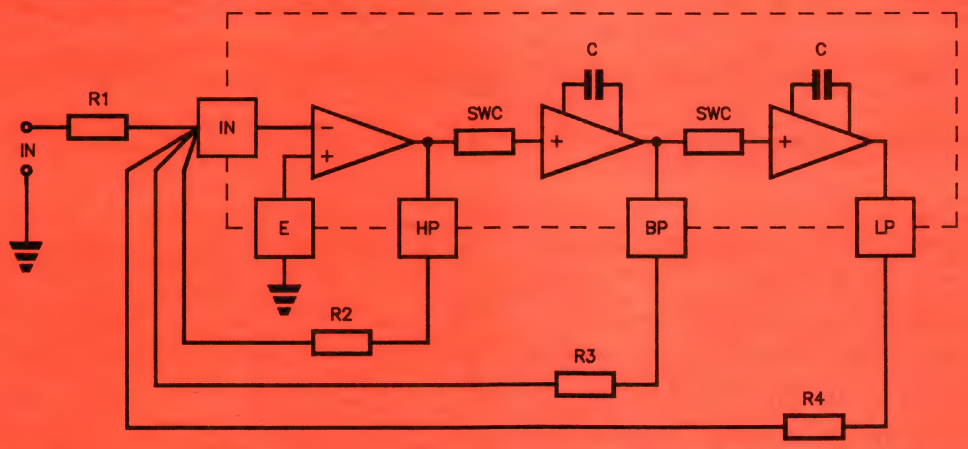


Figure 9.6. Simplified circuit of the filter part of the MF5. The boxes marked SWC are the switched capacitor 'resistors'.

The capacitors C are the normal integrator capacitors and are nothing to do with the switched capacitors.

ICs are available. They have three output terminals, have an FQ product of 200 000 and can be used for cutoff frequencies up to about 30 kHz. The internal configuration is slightly different from an analogue state variable filter in that there are pins for LP and BP outputs, but in this case the third pin can be used for HP, notch, or all-pass output.

The MF5 also contains a spare amplifier that can be used to generate notches, or as a low output impedance or buffer stage at the input or output of the filter. In addition, by applying a bias to pin 9 of the MF5, the clock-to-cutoff frequency ratio can be changed from 50:1 to 100:1, always with the proviso that the maximum clock frequency is 1 MHz. A separate TTL or CMOS clock has to be used with these ICs. The MF10 is simply two MF5s in the one 20 pin DIL package but without the spare amplifier.

These filters can be used in no less than nine different modes depending on the particular type of filter that you need, and on the clock-to-cutoff frequency that you choose. We will concentrate only on the use of these filters in their state variable modes since we have covered this type of filter in detail in part 7. In these modes, the three output terminals become LP, HP, and BP as with any state variable filter. For those who want to learn more about the other modes in which these filters can be used, the NS reference given under "Further reading" is an excellent source.

A simplified circuit of the MF5 in state variable mode is given in Figure 9.6. All of the switching mechanism has been omitted to make it easier to see the resemblance to the analogue state variable filter. The major difference is the lack of a specific resistor RQ to set the Q.

Since all four external resistors can now be varied, the Q can be set by resistor ratios, a circumstance that was not available in the state variable design that we chose to use in part 7. The two capacitors marked C are the usual integrator capacitors and are nothing to do with the switched capacitors that are used to simulate the frequency setting resistors (Rf in Figure 7.10b of part 7). However, because the switching capacitors are only a few pF, which makes them behave as high valued tuning resistors, the integrator capacitors have much smaller values than those normally used in analogue state variable filters.

Clocks

Figure 9.7 shows three easy ways to generate the necessary clock signal. At a) is a simple CMOS Schmitt trigger oscillator with the frequency controlled by R. Alternatively, if you happen to have a CMOS hex inverter, you can use the circuit at b). The frequency stability of this circuit is a bit better than that of the Schmitt trigger. For a 5 V supply, the frequency in MHz is approximately 260/R/C where R is in Ohms and C in nF.

For even better stability, but with a poorer square wave, you can use the circuit at c). This uses the LM319 as a comparator/Schmitt trigger oscillator. The LM319 is a dual high speed comparator that works quite well with a +5 V supply and generates TTL levels. This IC needs short connections and good bypassing. For frequencies up to about 50 kHz, the frequency in MHz is 670/R/C with R in Ohms and C in nF. Above this, the frequency gets progressively lower than that calculated, particularly if R is less than about 4k7. You will need to experiment to find the best combination of R & C to give the required frequency and an acceptable waveform.

If you are really keen on stability, you could use a crystal oscillator and divide the frequency down using a CD4040 or similar CMOS divider. With ± 5 V supplies, connecting the level shift pin (pin 7 on MF5, pin 9 on the MF10) to system ground will accommodate either CMOS or TTL clocks. ▷

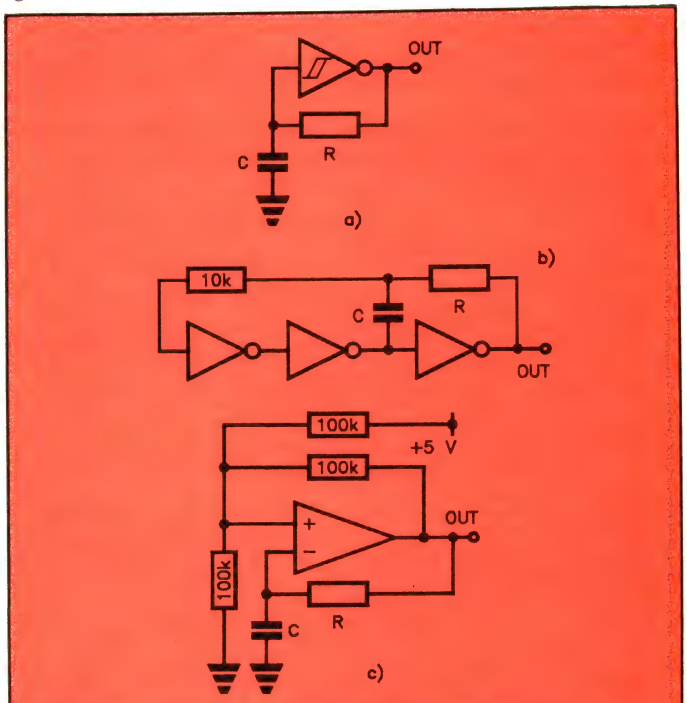


Figure 9.7. Three clocks suitable for use with the MF series ICs; (a) uses part of a 74HC14 Schmitt trigger IC, (b) uses three hex inverters from a 74HC04 and c) uses an LM319. All 3 clocks use a single +5 V supply.

Chebychev filters

The MF5 and MF10 are ideal devices for making Chebychev filters. The GWBASIC program of Figure 9.8 does the complete design for you. It does not ask for the cutoff (–3dB) frequency but asks where the response is down by the ripple amplitude. These ICs have more restrictions than the analogue state variable filters that we have met before, since the latter use + and –15 V supplies.

The program takes care of such things as the correct order of the blocks, adjusting the gain of high Q sections to reduce the chance of overload, resetting the gain of later stages to bring the overall gain back to approximately 1, and so on. There are warning messages if the necessary clock frequency, Q, or FQ product gets too high. If the filter order is odd, the program will suggest putting a simple RC or CR filter followed by a buffer amplifier with a gain of +1 in front of the filter. Since the dynamic range of these filters is limited to 80 dB, there has to be a compromise between the gains of the various blocks. If you want to push these filters to their limits, it is best to consult the NS databook for all the restrictions and to do the calculations by hand (very messy).

As with all state variable designs, it is essential to find the maximum input signal level that the filter can handle by checking the waveforms at each output terminal to make sure there is no overloading. Sharp cutoff BP and BR filters of orders greater than about 6 will give trouble because of their high Qs. BR filters have a notch at the centre frequency in each block, hence the need for RH and RL. They also need a separate amplifier to reset the overall gain to 1.

Figure 9.9 is the circuit of a 5th order LP filter, 0.1 dB down at 3 kHz, and 34 dB down at 5.5 kHz. To keep the IC count down, an MF10 is used rather than two MF5s. Since this filter was to be followed by a high impedance FET input amplifier, the RC filter was not buffered and used at the input as suggested by the program but simply used without buffering at the output. The frequency response was within 0.5 dB of the calculated value to 4 kHz and was 1.2 dB lower than calculated at 6 kHz, mainly because the 100k in the RC filter should be 98k.

With all switched capacitor filter blocks that use a separate input resistor, multiplying the values of all the resistors in a block by a constant has no effect on the design. So, if you find that some resistor values are particularly low, multiplying all ▷

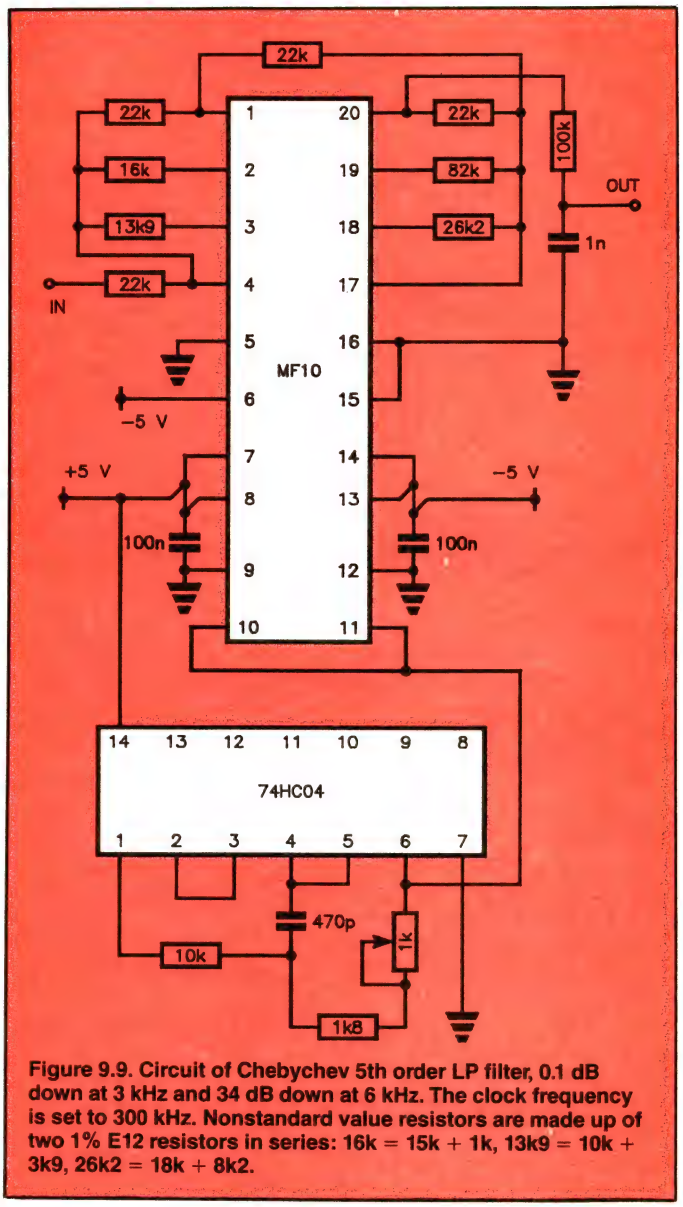


Figure 9.9. Circuit of Chebychev 5th order LP filter, 0.1 dB down at 3 kHz and 34 dB down at 6 kHz. The clock frequency is set to 300 kHz. Nonstandard value resistors are made up of two 1% E12 resistors in series: 16k = 15k + 1k, 13k9 = 10k + 3k9, 26k2 = 18k + 8k2.

Figure 9.8. GWBASIC programme to design Chebychev LP, HP, BP, and BR switched capacitor filters.

```
10 PRINT "                    Design of"
20 PRINT "                Switched Capacitor"
30 PRINT "      Chebychev LP, HP, BP, & BR filters."
40 PRINT "    Copyright Aguila Holdings Pty Ltd 1988":PRINT
50 DIM F(20),Q(20),RA(24),RS(24)
60 REM _____GENERATE E12 RESISTORS FROM 22k TO 1.8M _____
70 DATA 2.2,2.7,3.3,3.9,4.7,5.6,6.8,8.2,10,12,15,18
80 FOR I=1 TO 12:READ RA(I):RS(I)=10000!*RA(I):RS(I+12)=10*RS(I):NEXT I
90 REM _____GENERATE HYPERBOLIC FUNCTIONS _____
100 DEF FNACOSH(X)=LOG(X+SQR(X*X-1)):DEF FNSINH(X)=(EXP(X)-EXP(-X))/2:DEF FNCOSH
(X)=(EXP(X)+EXP(-X))/2:DEF FNASINH(X)=LOG(X+SQR(X*X+1))
110 PI=3.141592654#:LGE=.4342944819#:G=1
120 REM _____ FILTER DATA INPUT _____
130 PRINT "What type of filter would you like to design ?"
140 PRINT "1. Low pass "
150 PRINT "2. High pass "
160 PRINT "3. Band pass "
170 PRINT "4. Band reject "
180 PRINT "5. None, Quit."
190 INPUT "Please enter the appropriate integer.",X
200 IF X=5 THEN 1230
210 IF(X<1 OR X>5)THEN 130
220 INPUT "What ripple would you like in the passband [ dB ] ?",RIPL: IF RIPL<0
THEN 220
230 IF RIPL>6 THEN PRINT " That ripple is ridiculous.":GOTO 220
240 IF(X=1 OR X=2)THEN PRINT USING "At what frequency [ Hz ] is the response dow
n by #.## dB ";RIPL:INPUT FC:IF FC<=0 THEN 240 ELSE 280
250 INPUT "What is the centre frequency [ Hz ] ?",FC:IF FC<=0 THEN 250
260 PRINT USING "What is the bandwidth [ Hz ] over which the response is #.## dB
 down";RIPL:INPUT BW:IF BW<=0 THEN 260
270 FL=(-BW+SQR(BW*BW+4*FC*FC))/2:FU=FL+BW:IF FL<=0 THEN PRINT"That bandwidth is
 too wide for the centre frequency.":GOTO 250
280 INPUT "At what frequency [ Hz ] in the stopband is the attenuation known ?",
F1:IF F1<=0 THEN 280
290 IF((X=1 AND F1<=FC) OR (X=2 AND F1>=FC) OR (X=3 AND (F1>=FL AND F1<=FU)) OR
(X=4 AND (F1<=FL OR F1>=FU)))THEN 300 ELSE 310
300 PRINT"That frequency is not in the stopband.": GOTO 280
310 IF (X=4 AND F1=FC)THEN PRINT"Sorry I can't use the centre frequency, please
choose another frequency.":GOTO 280
320 INPUT "What is the attenuation [ dB ] at that frequency ?",AMAX:IF AMAX<=3 T
HEN PRINT"There must be more than 3 dB attenuation in the stopband.":GOTO 320
330 REM _____ SELECT APPROPRIATE Omega(N) _____
340 ON X GOTO 350,360,370,380,1230
350 WN=F1/FC : GOTO 400
360 WN=FC/F1 : GOTO 400
370 WN=ABS((F1*F1-FC*FC)/BW/F1) : GOTO 400
380 WN=ABS(F1*BW/(FC*FC-F1*F1))
390 REM _____ CALCULATE FILTER ORDER _____
400 N=INT(FNACOSH(SQR((10^(.1*AMAX)-1)/(10^(.1*RIPL)-1)))/FNACOSH(WN))+1:IF N MO
D 2=0 THEN ODD=0 ELSE ODD=1
410 IF X=1 OR X=2 THEN N1=N:N2=10 ELSE N1=2*N:N2=19
420 PRINT "This filter is of order ";N1:ANGLE=PI/N/2
430 IF N>N2 THEN PRINT "Sorry I can only calculate components for filters of ord
er less than";N2 : GOTO 130
440 REM _____ SET CLOCK FREQUENCY _____
450 CSW=0:FCLOCK=100*FC:IF FCLOCK>=1000000! THEN FCLOCK=50*FC:CSW=1
460 IF FCLOCK>=1000000! THEN PRINT "The necessary clock frequency is too high.":
GOTO 1230
470 REM _____NORMALIZED LOW PASS DESIGN _____
480 EP=SQR(10^(.1*RIPL)-1):A1=FNASINH(1/EP)/N:E=FNSINH(A1)
490 FINISH=(N+1)/2:IF ODD=0 THEN FINISH=N/2
500 FOR I=1 TO FINISH:S(I)=E*SIN((2*I-1)*ANGLE):IO(I)=FNCOSH(A1)*COS((2*I-1)*ANG
LE)
510 O(I)=SQR(S(I)*S(I)+IO(I)*IO(I)):T(I)=ATN(IO(I)/S(I))
520 Q(I)=.5/COS(T(I)):F(I)=O(I):NEXT I
530 ON X GOTO 550,570,590,590,1230
540 REM _____ DENORMALIZE LOW PASS FILTER _____
550 FOR I=1 TO FINISH:F(I)=FC*F(I):NEXT I:GOTO 730
560 REM _____ CONVERT TO HIGH PASS DESIGN _____
570 FOR I=1 TO FINISH:F(I)=FC/F(I):NEXT I:GOTO 730
580 REM _____ CONVERT TO BAND PASS & BAND REJECT DESIGN _____
590 FOR I=1 TO FINISH
600 IF X=4 THEN F(I)=1/F(I)
610 IF I=(N+1)/2 THEN Q(I)=FC/BW/F(I):F(I)=FC:GOTO 670
620 A=F(I)*F(I)*(1-.5/Q(I)/Q(I))+4*FC*FC/BW/BW
630 B=SQR(A*A+F(I)^4*(1-.25/Q(I)/Q(I))/Q(I)/Q(I))
640 X1=SQR(.5*(B-A)):X2=.5*F(I)/Q(I):Y1=SQR(.5*(B+A)):Y2=F(I)*SQR(1-.25/Q(I)/Q(I
))
650 F(I)=.5*BW*SQR((X1-X2)^2+(Y2-Y1)^2):Q(I)=F(I)/BW/ABS(X1-X2)
660 F(N+1-I)=.5*BW*SQR((X1+X2)^2+(Y1+Y2)^2):Q(N+1-I)=F(N+1-I)/BW/ABS(X1+X2)
670 NEXT I:IF X<>3 THEN 720
680 FOR I=1 TO N:F1=F(I)/FC
690 G=G*F1/Q(I)/SQR(((F1^2-1)^2+(F1/Q(I))^2))
700 NEXT I:G=1/G:GOTO 720
710 REM _____ PRINT RESULTS _____
720 IF X=3 OR X=4 THEN FINISH=N
730 FOR K=1 TO FINISH:I=FINISH+1-K
740 PRINT:PRINT USING "Filter block number ##";K:PRINT
750 FQP=F(I)*Q(I):PRINT USING "FQ product = ######.";FQP
760 IF FQP>200000! AND FQP<250000! THEN PRINT "This FQ product is right on the l
imit."
770 IF FQP>250000! THEN PRINT "This FQ product is too high for the IC.":GOTO 123
0
780 PRINT:ON X GOTO 790,800,810,820,1230
790 R1=22000:R4=22000:FF=F(I)/FC:R2=R4*FF^2:R3=Q(I)*SQR(R2*R4):GOTO 840
```

```
2200 REM _____ SET UP E12 RESISTORS _____
2210 DIM RA(24),RS(24)
2220 DATA 1.0,2.2,2.7,3.3,3.9,4.7,5.6,6.8,8.2,10,12,15,18
2230 FOR I=0 TO 12:READ RA(I):RS(I)=10000*RA(I):IF I>0 THEN RS(I+12)=10*RS(I)
2240 NEXT I
2250 REM _____ SET CLOCK FREQUENCY _____
2260 CSW=0:FCLOCK=100*FC:IF FCLOCK>=1000000! THEN FCLOCK=50*FC:CSW=1
2270 IF FCLOCK>=1000000! THEN PRINT "The necessary clock frequency is too high."
:GOTO 3410
2280 REM _____ CALCULATE RESISTOR VALUES _____
2290 PRINT:ON X GOTO 2310,2420,2550,2820,3410
2300 REM _____ LOW PASS _____
2310 IF ODD=1 THEN I=1:QP(I)=Q(V+1):GOSUB 2950
2320 REM  For 1st block need R1
2330 L=1:I=1:FP(I)=P1(V):QP(I)=Q(V):FZ(I)=F1(V)
2340 R1(I)=RS(L):R4(I)=R1(I):R2(I)=R4(I)*P(V)^2:R3(I)=Q(V)*SQR(R2(I)*R4(I))
2350 IF R2(I)<RS(0) OR R3(I)<RS(0) THEN L=L+1:GOTO 2340
2360 RL(I)=RS(1):RH(I)=RL(I)*F(V)^2
2370 REM  2nd block onwards
2380 FOR I=2 TO V:FP(I)=P1(V+1-I):QP(I)=Q(V+1-I):FZ(I)=F1(V+1-I)
2390 R1(I)=RL(I-1):R4(I)=R1(I):R2(I)=R4(I)*P(V+1-I)^2:R3(I)=Q(V+1-I)*SQR(R2(I)*R
4(I)):RL(I)=RS(1):RH(I)=RL(I)*F(V+1-I)^2:RG=RL(I):NEXT I
2400 FOR I=1 TO V:NUM=I:FINISH=V:GOSUB 3370:GOSUB 2950:NEXT I:GOTO 3410
2410 REM _____ HIGH PASS _____
2420 IF ODD=1 THEN I=1:QP(I)=Q(V+1):GOSUB 2950
2430 L=1:I=1:FP(I)=P1(V):QP(I)=Q(V):FZ(I)=F1(V)
2440 REM  For 1st block need R1
2450 R1(I)=RS(L):R2(I)=R1(I):R4(I)=R2(I)*P(V)^2:R3(I)=Q(V)*SQR(R2(I)*R4(I))
2460 IF R3(I)<RS(0) OR R4(I)<RS(0) THEN L=L+1:GOTO 2450
2470 RH(I)=RS(1):RL(I)=RH(I)*F(V)^2
2480 REM  2nd block onwards
2490 FOR I=2 TO V:FP(I)=P1(V+1-I):QP(I)=Q(V+1-I):FZ(I)=F1(V+1-I)
2500 R1(I)=RH(I-1):R2(I)=R1(I):R4(I)=R2(I)*P(V+1-I)^2:R3(I)=Q(V+1-I)*SQR(R2(I)*R
4(I)):RH(I)=RS(1):RL(I)=RH(I)*F(V+1-I)^2:RG=RH(I):NEXT I
2510 FOR I=1 TO V:NUM=I:FINISH=V:GOSUB 3370:GOSUB 2950:NEXT I:GOTO 3410
2520 REM _____ BAND PASS _____
2530 I=0:FINISH=2*V:IF ODD=1 THEN FINISH=2*V+1
2540 REM  Calculate overall gain
2550 GG=1:FOR I=1 TO 2*V:FZ=F1(I)/FC:FP=P1(I)/FC:GG=GG*(FZ^2-1)/SQR((FP^2-1)^2+(
FP/Q(I))^2):NEXT I:GG=ABS(GG)
2560 REM  Alternate low & high frequency poles
2570 I=0:FINISH=2*V:IF ODD=1 THEN FINISH=2*V+1
2580 FOR M=1 TO V:I=I+1:L=1:J=V+1-M:K=J:J1=2*V+1-M:K1=J1:FP(I)=P1(K):QP(I)=Q(K):
FZ(I)=F1(J):G=INT(QP(1))+1
2590 IF I>1 THEN 2630 ELSE L=0
2600 REM  For 1st block need R1
2610 R4(I)=RS(L):R1(I)=G*R4(I):R2(I)=R4(I)*(FP(I)/FC)^2:R3(I)=QP(I)*SQR(R2(I)*R4
(I)):RL(I)=RS(1):RH(I)=RL(I)*(FZ(I)/FC)^2:IF R2(I)<RS(0) THEN L=L+1:GOTO 2610 EL
SE 2670
2620 REM  2nd low frequency block onwards
2630 R4(I)=RH(I-1):R2(I)=R4(I)*(FP(I)/FC)^2:R3(I)=QP(I)*SQR(R2(I)*R4(I)):R1(I)=R
4(I)
2640 RL(I)=RS(1):RH(I)=RL(I)*(FZ(I)/FC)^2
2650 IF R2(I)<RS(0) OR R3(I)<RS(0) THEN L=L+1:GOTO 2630
2660 REM
2670 L=1:I=I+1:FP(I)=P1(K1):QP(I)=Q(K1):FZ(I)=F1(J1)
2680 REM  Calculate internal gain product
2690 IF M=V AND ODD=0 THEN PROD=1:FOR I=1 TO 2*V-1:PROD=PROD*RH(I)/R2(I):NEXT I
ELSE 2740
2700 R3(I)=PROD*R1(1)/GG:R2(I)=R3(I)*FP(I)/FC/QP(I):R4(I)=R3(I)*FC/FP(I)/QP(I):F
ACTOR=1
2710 IF R3(I)<RS(0) OR R2(I)<RS(0) OR R4(I)<RS(0) THEN FACTOR=FACTOR*2:R3(I)=2*R
3(I):R2(I)=2*R2(I):R4(I)=2*R4(I):GOTO 2710
2720 RH(I)=RS(1):RL(I)=RH(I)*(FC/FZ(I))^2:RG=RL(I)/FACTOR:GOTO 2770
2730 REM  2nd high frequency block onwards
2740 R2(I)=RL(I-1):R4(I)=R2(I)*(FC/FP(I))^2:R3(I)=QP(I)*SQR(R2(I)*R4(I))
2750 RH(I)=RS(1):RL(I)=RH(I)*(FC/FZ(I))^2
2760 IF R2(I)<RS(0) OR R3(I)<RS(0) THEN L=L+1:GOTO 2740
2770 NEXT M:FOR I=1 TO 2*V:NUM=I:GOSUB 3370:GOSUB 3010:NEXT I
2780 REM  Block without notch for odd orders
2790 IF ODD=1 THEN PROD=1:FOR I=1 TO 2*V:PROD=PROD*RH(I)/R2(I):NEXT I ELSE 3410
2800 I=2*V+1:FP(I)=FC:QP(I)=Q(I):R3(I)=PROD*R1(1)/GG:R2(I)=R3(I)/QP(I):R4(I)=R2(
I):GOSUB 3370:GOSUB 3010
2810 REM _____ BAND REJECT _____
2820 FINISH=2*V:I=0:L=1:FP(I)=P1(2*V+1):QP(I)=Q(2*V+1):FZ(I)=F1(2*V)
2830 R4(I)=RS(L):R2(I)=R4(I):R3(I)=QP(I)*R4(I):R1(I)=R4(I):RH(I)=R4(I):RL(I)=RH(
I)*(FC/FZ(I))^2
2840 FOR M=1 TO V:I=I+1
2850 L=1:J=V+1-M:K=J:J1=2*V-M:K1=2*V+1-M:FP(I)=P1(K):QP(I)=Q(K):FZ(I)=F1(J)
2860 MF=QP(1)/3:R2(I)=RH(I-1)/MF:R4(I)=R2(I)*(FC/FP(I))^2:R3(I)=QP(I)*SQR(R2(I)*
R4(I)):R1(I)=R4(I)
2870 RL(I)=RS(1):RH(I)=RL(I)*(FZ(I)/FC)^2
2880 REM
2890 L=1:I=I+1:FP(I)=P1(K1):QP(I)=Q(K1):FZ(I)=F1(J1):IF I=2*V THEN FZ(I)=FC
2900 R4(I)=RL(I-1):R2(I)=R4(I)*(FP(I)/FC)^2:R3(I)=QP(I)*SQR(R2(I)*R4(I))
2910 RH(I)=RS(1):RL(I)=RH(I)*(FZ(I)/FC)^2:R1(I)=R2(I):RG=RH(I)*MF
2920 IF R2(I)<10000 OR R3(I)<10000 THEN L=L+1:GOTO 2900
2930 NEXT M:FOR I=0 TO 2*V:NUM=I+1:GOSUB 3370:GOSUB 3010:NEXT I:GOTO 3410
2940 REM _____ DISPLAY VALUES _____
2950 IF X=1 AND QP(I)=.5 THEN 2960 ELSE 2980
2960 C=1E-08:RR=.5/P1/P1(I)/C:IF RR<22000 THEN RR=RR*10:C=C/10
2970 GOSUB 3160:CC=C:GOSUB 3320:PRINT USING "Use buffered RC filter, R=###.###\
   \, C=\      \";RR,RR$,CC$:GOTO 3140
2980 IF X=2 AND QP(I)=.5 THEN 2990 ELSE 3010
2990 C=1E-09:RR=.5/P1/P1(I)/C:IF R<22000 THEN C=2.2E-10:RR=.5/P1/P1(I)/C
3000 GOSUB 3160:CC=C:GOSUB 3320:PRINT USING "Use buffered CR filter, C=\      \,
   R=###.###\      \";CC$,RR,RR$:GOTO 3140
3010 RR=FP(I):GOSUB 3270:PRINT USING "Tuning frequency=###.###\  \";RR,RR$:PRINT
 USING "              Q=###.###";QP(I)
3020 FQP=FP(I)*QP(I):PRINT USING "       FQ product= ######";FQP
3030 IF FQP>200000! AND FQP<250000! THEN PRINT "This FQ product is right on the
limit."
3040 IF FQP>250000! THEN PRINT "This FQ product is too high for the IC.":GOTO 34
10
3050 IF X=3 AND I=2*V+1 THEN 3070 ELSE RR=FZ(I):GOSUB 3270:PRINT USING " Notch f
requency=###.###\  \";RR,RR$
3060 RR=R1(I):GOSUB 3160:IF I=0 OR (I=1 AND X<4) THEN PRINT USING "
 R1=###.###\      \";RR,RR$
3070 RR=R2(I):GOSUB 3160:PRINT USING "              R2=###.###\      \";RR,RR$
3080 RR=R3(I):GOSUB 3160:PRINT USING "              R3=###.###\      \";RR,RR$
3090 RR=R4(I):GOSUB 3160:PRINT USING "              R4=###.###\      \";RR,RR$
3100 IF X=3 AND I=2*V+1 THEN PRINT "This block has no notch. Output is taken fro
m the BP terminal.":GOTO 3410
3110 RR=RL(I):GOSUB 3160:PRINT USING "              RL=###.###\      \";RR,RR$
3120 RR=RH(I):GOSUB 3160:PRINT USING "              RH=###.###\      \";RR,RR$
3130 IF I=FINISH THEN RR=RG:GOSUB 3160:PRINT USING "             RG=###.###\
  \, Final summing amp needed.";RR,RR$:GOTO 3410
3140 INPUT "Press ENTER to continue.",SS$:RETURN
3150 REM _____ RESISTOR SUBROUTINE _____
3160 IF RR>1000000! THEN RR=RR/1000000!:RR$=" MOhms ":GOTO 3190
3170 IF RR>1000! THEN RR=RR/1000!:RR$=" kOhms ":GOTO 3190
3180 RR$=" Ohms  "
3190 RETURN
3200 REM _____ SUBROUTINE TO SELECT E12 RESISTOR _____
3210 IF R1>1800000! THEN PRINT "The Q of this circuit is too high.":GOTO 3410
3220 FOR J=24 TO 1 STEP -1
3230 IF R1>RS(J) THEN R1=RS(J+1):GOTO 3250
3240 NEXT J
3250 RETURN
3260 REM _____ FREQUENCY SUBROUTINE _____
3270 IF RR>=1000000! THEN RR=RR/1000000!:RR$=" MHz":GOTO 3300
3280 IF RR>=1000! THEN RR=RR/1000!:RR$=" kHz":GOTO 3300
3290 RR$=" Hz "
3300 RETURN
3310 REM _____ CAPACITANCE SUBROUTINE _____
3320 IF CC=1E-08 THEN CC$=".01 uF":GOTO 3350
3330 IF CC=1E-09 THEN CC$="1.0 nF":GOTO 3350
3340 IF CC=2.2E-10 THEN CC$="220 pF"
3350 RETURN
3360 REM _____ HEADING SUBROUTINE _____
3370 PRINT:PRINT USING "Filter block number #";NUM:PRINT
3380 IF CSW=1 THEN PRINT "Set clock ratio to 50:1." ELSE PRINT "Set clock ratio
to 100:1"
3390 RR=FCLOCK:GOSUB 3270:PRINT USING " Clock Frequency=###.###\  \";RR,RR$
3400 RETURN
3410 PRINT:PRINT "End of programme.":END
```

Figure 9.10. GWBASIC programme to design elliptic LP, HP, BP, and BR switched capacitor filters. This programme is intended to be merged onto the end of yet another copy of Fig 5.1.

```
800 R1=22000:R2=22000:FF=FC/F(I):R4=R2*FF^2:R3=Q(I)*SQR(R2*R4):GOTO 840
810 R1=22000:R3=R1*G^(1/N):R2=R3*F(I)/FC/Q(I):R4=R3*FC/F(I)/Q(I):GOTO 840
820 R1=22000:IF K=1 AND Q(I)>3 THEN R1=R1*Q(I)/2:GOSUB 1080:RG=R1
830 R4=22000:R2=R4*(F(I)/FC)^2:R3=Q(I)*SQR(R2*R4):RL=22000:RH=22000
840 IF X=1 AND Q(I)=.5 THEN 850 ELSE 870
850 C=1E-08:RR=.5/P1/F(I)/C:IF RR<22000 THEN RR=RR*10:C=C/10
860 GOSUB 1030:CC=C:GOSUB 1190:PRINT USING "Use buffered RC filter, R=###.###\
   \, C=\      \";RR,RR$,CC$:GOTO 1010
870 IF X=2 AND Q(I)=.5 THEN 880 ELSE 900
880 C=1E-09:RR=.5/P1/F(I)/C:IF R<22000 THEN C=2.2E-10:RR=.5/P1/F(I)/C
890 GOSUB 1030:CC=C:GOSUB 1190:PRINT USING "Use buffered CR filter, C=\      \,
   R=###.###\      \";CC$,RR,RR$:GOTO 1010
900 IF CSW=1 THEN PRINT "Set clock ratio to 50:1." ELSE PRINT "Set clock ratio t
o 100:1"
910 RR=FCLOCK:GOSUB 1140:PRINT USING " Clock Frequency=###.###\  \";RR,RR$
920 RR=F(I):GOSUB 1140:PRINT USING "Tuning frequency=###.###\  \";RR,RR$:PRINT U
SING "              Q=###.###";Q(I)
925 IF X=4 AND K>1 THEN 940
930 RR=R1:GOSUB 1030:PRINT USING "              R1=###.###\      \";RR,RR$
940 RR=R2:GOSUB 1030:PRINT USING "              R2=###.###\      \";RR,RR$
950 RR=R3:GOSUB 1030:PRINT USING "              R3=###.###\      \";RR,RR$
960 RR=R4:GOSUB 1030:PRINT USING "              R4=###.###\      \";RR,RR$
970 IF X<>4 THEN 1010
980 RR=RL:GOSUB 1030:PRINT USING "              RL=###.###\      \";RR,RR$
990 RR=RH:GOSUB 1030:PRINT USING "              RH=###.###\      \";RR,RR$
1000 IF K=FINISH THEN RR=RG:GOSUB 1030:PRINT USING "             RG=###.###\
  \";RR,RR$
1010 INPUT "Press ENTER to continue.",SS$:NEXT K:GOTO 1230
1020 REM _____ RESISTOR SUBROUTINE _____
1030 IF RR>1000000! THEN RR=RR/1000000!:RR$=" MOhms ":GOTO 1060
1040 IF RR>1000! THEN RR=RR/1000!:RR$=" kOhms ":GOTO 1060
1050 RR$=" Ohms  "
1060 RETURN
1070 REM _____ SUBROUTINE TO SELECT E12 RESISTOR _____
1080 IF R1>1800000! THEN PRINT "The Q of this circuit is too high.":GOTO 1230
1090 FOR J=24 TO 1 STEP -1
1100 IF R1>RS(J) THEN R1=RS(J+1):GOTO 1120
1110 NEXT J
1120 RETURN
1130 REM _____ FREQUENCY SUBROUTINE _____
1140 IF RR>=1000000! THEN RR=RR/1000000!:RR$=" MHz":GOTO 1170
1150 IF RR>=1000! THEN RR=RR/1000!:RR$=" kHz":GOTO 1170
1160 RR$=" Hz "
1170 RETURN
1180 REM _____ CAPACITANCE SUBROUTINE _____
1190 IF CC=1E-08 THEN CC$=".01 uF":GOTO 1220
1200 IF CC=1E-09 THEN CC$="1.0 nF":GOTO 1220
1210 IF CC=2.2E-10 THEN CC$="220 pF"
1220 RETURN
1230 PRINT:PRINT "End of programme.":END
```

resistor values in that block by 2, or even 10, is quite alright. Likewise, if some of the values are much too high, divide them all by a constant. You can multiply one block by one constant and another block by another constant if you like.

For filters that need notches, such as the BR filter, two resistors feed from the previous stage to the input terminal of a filter block. RL connects from the LP terminal of the previous stage and RH from the HP terminal.

Elliptic filters

The program of Figure 9.10 does the complete design of elliptic switched capacitor filters. It is intended to be merged onto the end of a copy of the program of Figure 5.1. Remember to call the new document "FIG910" or some such. You might like to add a line 15 saying PRINT "Switched Capacitor" with enough spaces after the first inverted commas to line up the heading.

Because of the comparative ease with which switched capacitor filters overload, the order of the blocks and the tuning frequency and notch frequencies of each block in an elliptic filter have to be chosen with considerable care. In addition, particularly with BP and BR filters, the way in which an overall gain of unity is achieved is a bit of a problem. Consequently, in the GWBASIC program of Figure 9.10, it is not possible to change the values of any of the resistors in any of the filter blocks in the way that you can with Chebychev filters. This program assumes that each filter block will be part of an MF10, or an MF5 in which the spare amplifier is not used between blocks. This means that the input terminal of each block after the first is used as a summing junction for the ▷

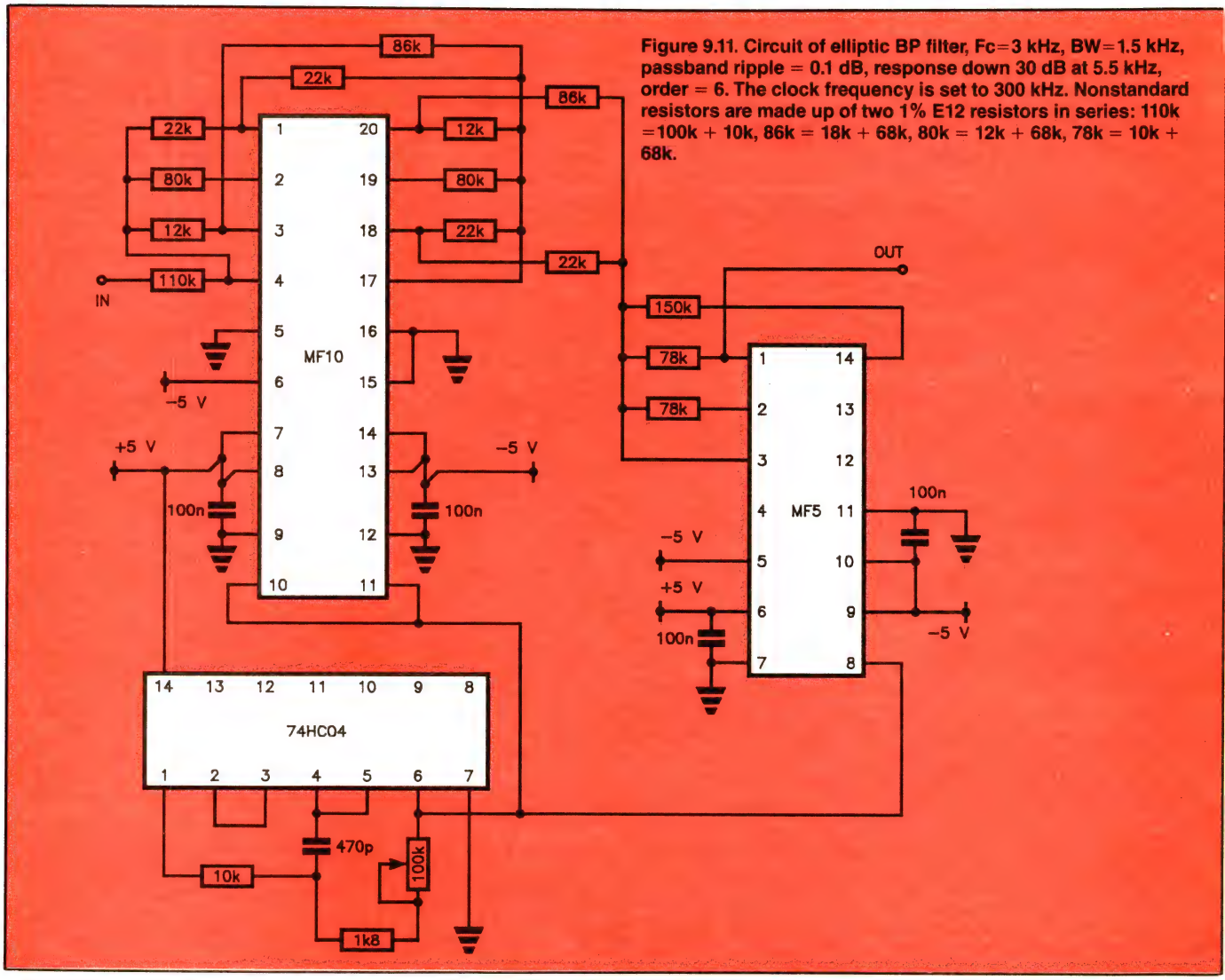


Figure 9.11. Circuit of elliptic BP filter, Fc=3 kHz, BW=1.5 kHz, passband ripple = 0.1 dB, response down 30 dB at 5.5 kHz, order = 6. The clock frequency is set to 300 kHz. Nonstandard resistors are made up of two 1% E12 resistors in series: 110k =100k + 10k, 86k = 18k + 68k, 80k = 12k + 68k, 78k = 10k + 68k.

resistors defining the notch frequency for the previous block.

Odd order LP and HP filters require a buffered RC or CR filter to be placed before the main filter, the values for which are given. Some filters need a separate final summing amplifier to reset the gain to unity. The program tells you if this is needed and gives a value for RG, the gain setting resistor. Half an LM358 can be used as the amplifier since that IC will run quite nicely on + and –5 V, but the output is limited to about 1.8 Vrms. The value given for RG sets the gain somewhere between 0.5 and 2, depending on accumulated resistor tolerances. You can adjust the gain precisely to 1, or have any gain that you like by varying RG.

Figure 9.11 is the complete circuit of an elliptic BP filter having Fc = 3 kHz, BW = 1.5 kHz, response down 30 dB at 5.5 kHz, passband ripple = 0.1 dB, order = 3. The filter is made up of only 3 ICs, an MF10 an MF5, and a 74HC04, the latter providing the clock. The overall gain at 3 kHz is 1, and the maximum output level over the passband is 2.8 Vrms. Figure 9.12 shows the calculated and measured frequency responses without any RC anti-aliasing postfilter. This frequency response is presented because it shows the effect of clock hash on the depth of the notches. A simple RC postfilter will remove most of this and improve notch depth by 10-20 dB.

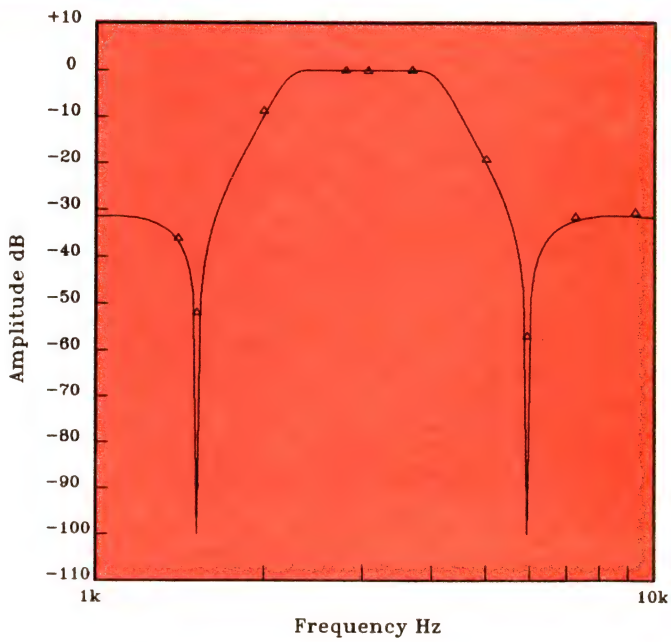


Figure 9.12. Frequency response of the filter of Figure 9.11 Continuous line is the calculated response, triangles are measured points. The notch depth is limited by clock feedthrough. This could be reduced by using an RC postfilter.

General construction

As far as good construction practice is concerned, the MF5 and MF10 must be treated as high gain audio amplifiers. Particularly with Qs greater than about 10, the input pins of the MF5 (pins 3 & 12) and the MF10 (pins 4 & 17) need to have the ▷

minimum possible amount of copper track and the minimum possible component lead length connected to them. You can have a lot of fun working out a suitable PC board layout to do this.

Despite the fact that these filters operate digitally within the IC, they can oscillate very nicely if you don't treat them with respect! For this reason it is often not possible to breadboard a high Q filter, you just have to commit yourself to designing a PCB. As you would expect, all power supply pins must be bypassed with 0.1 uF block and 1 nF ceramic capacitors to a separate earth from the signal earth.

Further reading

By far the best simple text on switched capacitor filters is the National Semiconductor Databook called "Switched Capacitor Filter Handbook", published in April 1985. It contains all the theory and the necessary equations to design any switched capacitor filter. It also has complete data on the MF series of filter ICs, an extensive set of filter tables, and a computer program for filter design.

For those who wish to delve more deeply into the theory of these filters, a good (but high powered) book is M.S.Ghausi & K.R.Laker "Modern Filter Design, Active RC and Switched Capacitor", published by Prentice Hall, NJ, 1981.

Conclusion

Over the last 9 chapters we have looked at a wide variety of filters and discussed their advantages and disadvantages. The filters that have been presented are easy to design and build and in most cases don't even need adjustment. If you have put the filter design programs into a computer you now have a complete set of tools that enable you to design almost any type of practical filter with the minimum of fuss. This puts you in a better position than those filter design engineers who rely entirely on filter tables and therefore modify the problem to fit the filter rather than the other way round.

It is worth emphasising that the computer programs included in the series are intended only as tools. You are the filter designer, not the programs. As with most other endeavours, there is no substitute for experience in attaining a smooth performance. After you have designed and built a few filters you will be able to avoid the obvious pitfalls.

When you first start, you can design a 10th order Chebychev LP switched capacitor filter without any trouble. Alas, after the fourth printed circuit board layout still oscillates you will get the message that perhaps that is not a particularly practical design and that the more stable, but difficult to tune, Sallen and Key version would be better after all. What you have just learnt is that computer programs do not guarantee success, they merely allow you to make your mistakes faster. At least that speeds up the process of getting your experience.

I hope you have had as much fun reading the series as I have had in writing it. Electronics is our hobby – or our profession! – because we enjoy playing about with circuits and suchlike. Knowing about filters can only add to that enjoyment.

THE COMPLETE SET OF FILTER DESIGN PROGRAMS published in this series, along with the programs for obtaining non-standard resistors and capacitors from standard values (published in Nov. '87), is available on 5.25" disk for just:

$65.00, post free.

The software runs under PC/MS-DOS on an IBM PC or close compatible.

If you earlier obtained the programs from Parts 1 to 7 and wish to update, the cost is just $5.50.

Send your orders to: "Filters Software", AEM, 347 Darling St, Balmain 2041 NSW. Cheques, money orders, Bankcard, Visa and Mastercard accepted. OR, phone (02)555 1677 and "pledge your plastic".

Eagle ELECTRONICS

FREE EXPERT ADVICE OFFERED TO ALL OUR CUSTOMERS.

It's all happening . . . this month at Eagle Electronics

KITS AEM 6000 POWER AMP $795.00

The ever popular Listening Post $39.95

6010 PRE-AMP $379.00

– top quality Eagle blueprint edition

6005 MODULES $139.95

EXCLUSIVE TO EAGLE –

the imported range of top quality Velleman Kits and accessories – send now for a free catalogue.

Stocking most AEM projects and pcb's since their beginning.

Now carrying a huge range of projects, tools and advice for the beginner.

(SHORT FORM) HASH HARRIERS $69.50 over 300 in use!

and many more. Phone now or come in and browse.

WATCH OUT FOR OUR GREAT NEW POWER AMP KIT! COMING SOON IN AEM!

MAIL AND PHONE ORDERS WELCOME.

Eagle Electronics Pty. Ltd.

54 Unley Road, Unley, S.A. 5061

TELEPHONE:

(08) 271 2885 ALLOW $10 FREIGHT WITH ORDERS

BANKCARD MasterCard VISA AMERICAN EXPRESS

The warmth of glowing filaments, and the smell of overcooked trannies

This issue we commence a regular column on restoring 'vintage' electronic equipment – covering old valve radios, test equipment, old military ('war surplus') equipment, audio gear and the like. We've spent some months gathering material, digging out sources and correspondents etc. If you're interested in collecting and restoring pre-1960 electronic technology, we'd like to hear from you. Share your experiences, hints and tips with other readers. We've lined-up Stephen Moignard of Resurrection Radio in Melbourne and Andrew Kay of The Vintage Wireless Radio Company in Sydney to contribute regular pieces for this column. Each month we'll cover practical aspects of vintage equipment, include items of general interest about the subject or specific equipment groups, and explain a little about the technology for those who grew up after its decline or those who need rusty memories renewed.

VALVE RADIOS have been very much a relic of earlier technology – the realm almost exclusively of small coteries of enthusiast collectors until recently. Interest in and appreciation of vintage, or valve radio technology is expanding to a much broader cross-section of collectors for a variety of reasons.

Valve radios are basically just that – radio receivers which employ valves (in the American parlance, vacuum tubes) which look, for those unfamiliar with the technology, like glass bottles or light globes of various sizes.

They flourished in the period 1920-1960, but most heavily populate the "Wireless Era", 1926 – 1950. By 1960, valves were no longer being incorporated into new radio receiver designs, as the cheaper, more easily manufactured new- fangled transistors had taken their place.

Since then, year by year, valve radios have been discarded as minor faults developed in them, and no-one was available to repair them, or it was not considered economically worthwhile.

Eventually, there were so few left that some clever people decided the time was ripe to restore these granddaddys of the computer age, and so let them stand as examples of engineering and design philosophies that have since passed from manufacturing in the modern world.

So why restore what many people have long regarded as junk? The main reasons given to me by most people involved in this field are summarised as follows.

Aesthetics: Valve radios represent and exhibit the designs and character of an era – a particularly optimistic and creative era in the 1930s and an increasingly futuristic era approaching the 1960s. More than in any other piece of household furniture, radio design was limited only by the imagination. All that was required functionally was a few knobs and a dial. The rest was open to experiment, and experiment they did!

Nostalgia: As in all things, memories of the past have a great bearing on the present. The radio that grandma or granddad used to own may have a particular intrigue now. The experience of listening to the same or similar sets to those with family significance can be very heartwarming.

Functional comparison: It may seem surprising, but in fact a radio of 1938 can sound comparable to or better than a radio made in 1988. The basic circuits of radios have changed little since the advent of the particularly effective superhetrodyne circuit some 50 years ago. Large speakers, solid cabinets and great attention to workmanship and quality combine to produce a remarkably mellow, listenable sound with ample volume and tuning range.

Investment: Vintage radios are increasing in value at a very rapid pace. Due to the sudden, or delayed, interest in them, the few nice ones that are to be found are highly sought after by collectors and the general public alike.

Quality, reliability, durability: It has often been mentioned to me by happy owners of valve radios that they really appreciate the craftsmanship evident in early radios. They comment on a lack of the "planned obsolescence" approach. These units were built to last, and indeed they have! I have commonly seen sets working, untouched, after 20 – 30 years. It is highly likely that the sets now being restored, given the quality of electronic components such as polyester capacitors not available to the original manufacturers, will outlive their new owners!

Simply put, many people just like valve radios more than modern ones.

Where to start

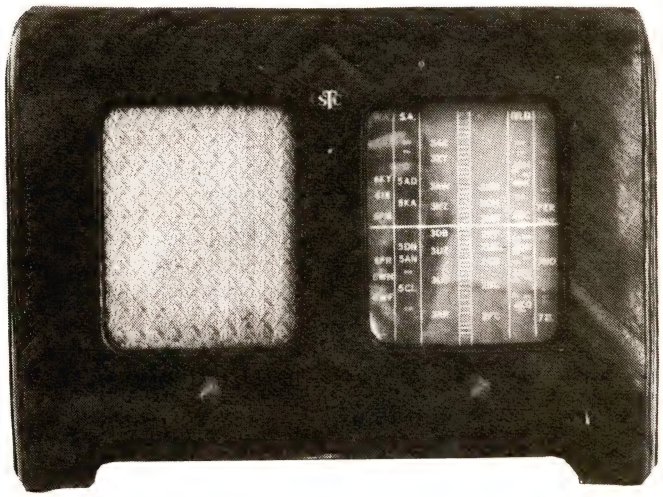
There are various ways to get in touch with someone with whom you can exchange ideas and information on valve radios, or who may undertake repairs if you are not confident of doing it yourself. For the enthusiast interested in collecting, or already involved to some extent, the **Historical Radio Society of Australia** is an organisation covering all types of old radios in all states of Australia. It conducts meetings and holds autions and outings of interest to old radio enthusiasts. Contact **Ray Kelly,** the president, or **Rex Wales,** the membership convenor, at **49 Sharon Rd, Springvale 3171 Vic.**

Two shops in Victoria currently sell and repair early radios. These are **Nostalgia Wireless** in **Union Rd, Surrey Hills 3127,** and **Resurrection Radios** at **14 Chapel St, Windsor 3181 Vic.** Both stock a large range of styles and vintages, with an enormous range of spare parts and magazines, etc., including some 30 000 valves.

Resurrection Radio has several more workshops planned for other states, and would be delighted to hear from anybody who may wish to be involved in something of that nature.

In New South Wales, there's the **Vintage Wireless Radio Company, 267A Johnston St, Annandale 2038 NSW.**

Early radios have become the first modern era "antiques", and they represent something new in old wares – they actually work, and very well at that! Why not dig out that old wireless of grandpa's out in the shed and have another look at it. It may transport you, with a bit of loving care, back into an era of swing and frivolity and youth such as no other relic can. . .



This mantel set was made by STC in 1948 and features a veneered wood cabinet and a linear, vertical dial.

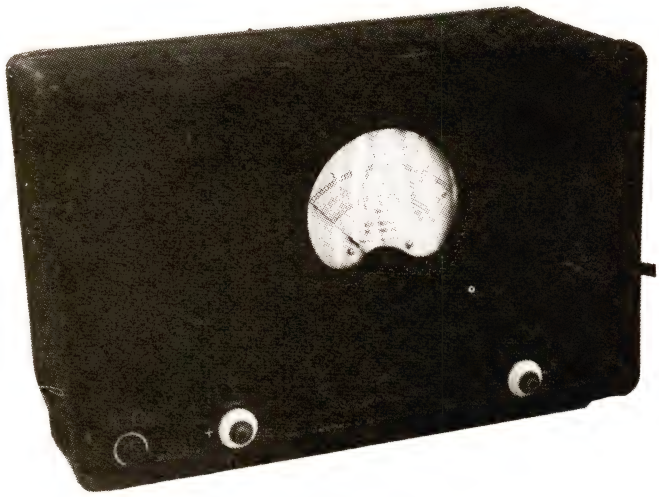
(Courtesy Andrew Kay.)

A personal perspective

Steven Moignard, managing director of Resurrection Radios presents this personal story of burgeoning interest in vintage radio.

"There are perhaps 250 000 early or pre-1949 valve radios in Australia. They are therefore not particularly rare, in many ways outdated and usually much the worse for wear. Why is it then, that old radios are so popular today?

"I discovered my first early wireless in 1986. I was in Langwarrin, Victoria, in a country gentleman's storage shed. I had just finished extracting an early 1956 Atlas TV set from under some barbecue grills, when I noticed a tall, thin



This "Palec" vacuum tube voltmeter, circa late-40s, was locally made by Paton Electrical and they were very expensive precision instruments, not commonly seen in your local service shop! (Courtesy Jamye Harrison.)

cabinet with very ornate knobs and a mother of pearl dial. I was intrigued enough to look inside, to find a primitive chassis, a field coil speaker and lots of air! I had to ask what it was, and ended up taking it home with me, fascinated.

"The set turned out to be an early 'Gibbs Radio' console, made in Melbourne around 1934. The experience of this acquisition led me to my next purchase, an AWA Fisk Radiola Model 37 bakelite cathedral, and I knew I was hooked.

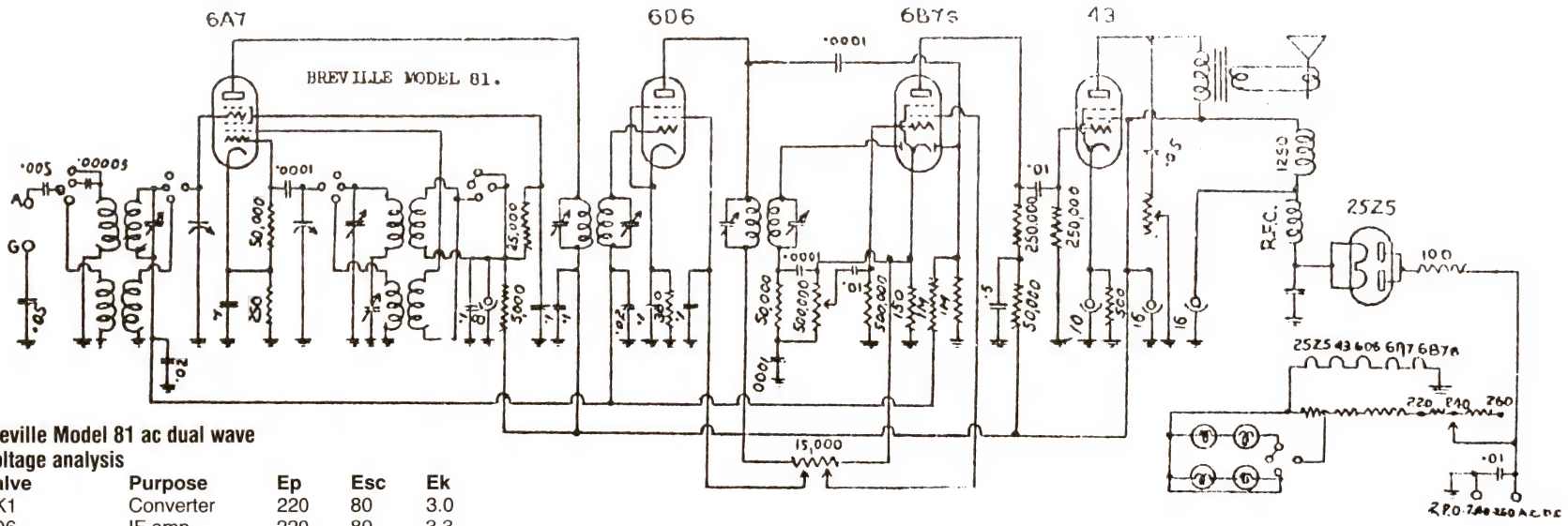
"Since those early days I have purchased and seen restored hundreds of valve radios, and have accumulated thousands upon thousands of related components.

"Let me admit at the outset that I am not a particularly technically minded person. Don't, however, let the apparent primitivism of early radio fool you. Repairs and restoration of early chassis require specific and highly developed technical skills and knowledge. The realm of the specialist valve equipment technician is a solitary one today – populated sparsely by experts without whom authentic restoration of some sets would be impossible. I have been fortunate enough to locate some of the best of these surviving technicians, including notably my chief technician, Jack, who I consider to be the unchallenged champion of the breed. Through our apprentices, his skill and knowledge will continue to be profitably exercised.

"I am more involved in the aesthetics of the pieces we work on, either for ourselves or for clients. I love the look of the old sets, the weight of them, their craftsmanship and quality of construction – and I am not alone in this. Thousands of collectors across Australia are hoarding virtually any set they can get, but I would guess that less than 10% of their stored sets would actually operate to the manufacturer's specifications.

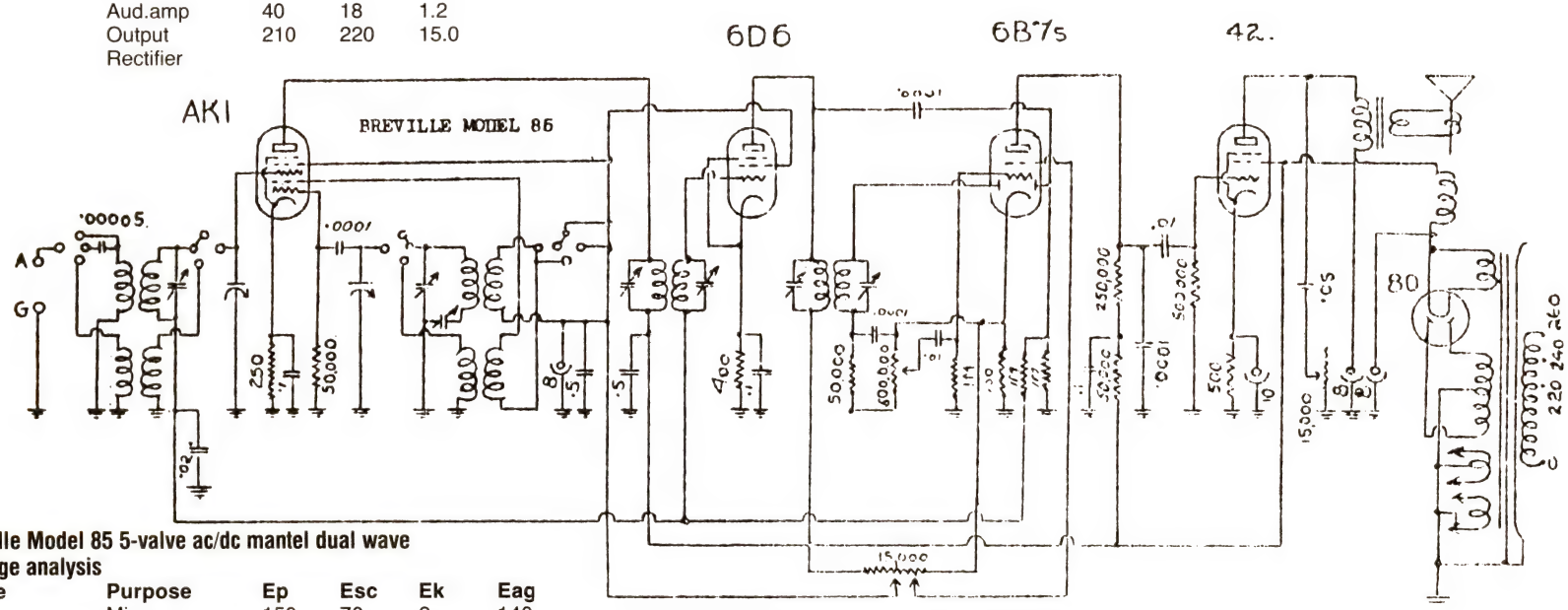
"There, then, is a good illustration of my idea of the goal of all restoration – not as an ideal, but as a practicality. It is a fact that any alterations to original circuits drastically shorten valve life, reduce performance and stress the components. These sets were built to be durable, and it should be an aim of all restorers to achieve these 'original specs'.

"The original specifications themselves are usually not too hard to locate. As any member of the number of radio ▷



Breville Model 81 ac dual wave
Voltage analysis

Valve	Purpose	Ep	Esc	Ek
AK1	Converter	220	80	3.0
6D6	IF amp	220	80	3.3
6B7	Det.AVC	40	18	1.2
6B7	Aud.amp	40	18	1.2
42	Output	210	220	15.0
80	Rectifier			



Breville Model 85 5-valve ac/dc mantel dual wave
Voltage analysis

Valve	Purpose	Ep	Esc	Ek	Eag
6A7	Mixer	150	70	2	140
6D6	IF amp	150	70	2	
6B7s	Demod AVC				
	AF amp	25	15	1.5	
43	Lowe amp	140	150	20	
25Z5	Rectifier	230			

Original circuits for the Breville models 81 and 85 radios. For those unfamiliar with the symbols, circuitry and nomenclature of "old time" circuitry, we'll be explaining it in coming issues. We'll also outline the dangers of "transformerless" sets like the model 81!

societies in Australia and internationally would know, someone somewhere is bound to have a copy of the correct schematic, even if only the OASM version. (This is a 15 volume Australian series containing 85% of circuits in use 1937-55.)

"Take my word for it – you should get a schematic and any other relevant information before you start a restoration.

"Another point to keep in mind – restoration is not cheap. What you save by doing-it-yourself rather than leaving it to the experts you may lose in time spent sitting stumped at the workbench. But press on – the rewards are considerable.

"The sound quality of many or most early sets is truly magnificent, the appearance divine and the sense of accomplishment as long lasting as the radio itself.

"I will endeavour over the coming months, with the assistance of my in-house expert Jack, to help any reader with individual problems with their sets, and will provide interesting anecdotes on radios, first hand and second hand, 1926 – 1955.

"We are working on the layout for the ideal valve workbench, and valve test equipment kits that have proven themselves useful. Occasionally Jack and I will describe a particularly fascinating model, or the occasional interesting collection we have come across.

"We will keep you informed – unlike the poor lad we heard about helping his boss with a repair back in the '40s. It seems he had discovered that the radio worked better when he held the aerial, so, using his initiative, he ducked out of the shop for five minutes to get the "parts" to effect a repair. He returned holding a parcel and smugly informed his employer "I think we've fixed the radio!" The boss unwrapped the parcel and was amused to find 2lb of steak – the closest thing the lad could think of to his own hand!

"Until next time, careful of the HT."

In Sydney, local collector and vintage radio and sound equipment enthusiast, John Murt, has proposed forming a society to be called "The Early Wireless and Sound Society of NSW." The inaugural meeting is scheduled for Friday June 24th. More details can be had by contacting John at **PO Box 623 Lane Cove 2066 NSW, or by phone on (02)488 8184.**

Radio of the Month

1935 – 1937 Breville Ferrodine – models 81, 83, 84 and 85

Breville, nowadays more commonly associated with toasters and kettles, manufactured radios here from around 1935 to 1950. One of the most popular designs was the 81-85 series which exemplifies the 1930s chassis design while displaying more conservative 1930s cabinet styles.

Each model used the rectangular 240 x 380 x 220 mm cabinet. They incorporated high quality walnut veneers and were fitted with bakelite escutcheons and gold gauze speaker cloths. Black timber trims were used to edge the plys and for decoration.

Valve complements changed with different models. The 81-83 models used type 80 (rectifier) and 42 (output), 6B7s (detector stage), 6D6 (IF amp) and AK1 (converter). The model 84, which used an ac voltage dropping resistor, had a 25Z5 rectifier, with lots of internal asbestos for heat shielding! In the later model 85, the P-mount Philips octode AK1 was replaced with a 6A7 converter.

Internal components were substantially board mounted and well laid out. The intermediate frequency (IF) on all models was 446 kHz – unusual and a reminder that pre-1937 sets use IFs of many frequencies – so carefully check circuits before alignment!

Keep your eyes out for your own Breville Ferrodine. It is a model well worth restoring. Further information is available from Resurrection Radio.

PRODUCT SAFETY RECALL

DICK SMITH ELECTRONICS PTY. LTD.

NOTICE TO CUSTOMERS

BEAT TRIGGERED STROBE KITS

Cat No. K-3153

sold in component form for customer construction

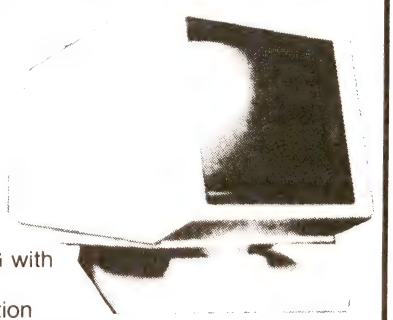
have been sold in all states and may, if proper safety procedures are ignored, constitute a serious risk when constructed, as the power switch supplied with some kits is incompatible with the wiring diagram.

Customers are asked to return this product, whether or not assembled, as a matter of urgency to the nearest Dick Smith Electronics store for immediate attention to the problem.

We apologise for any inconvenience caused. Further enquiries may be made by contacting Rex Callaghan, Technical Service Division (02) 888 3200 or your nearest Dick Smith store.

HIGH RESOLUTION MONOCHROME MONITOR

$165.00
+ 20% sales tax if applicable



12" MODEL GM-1211G with Tilt and Swivel Base.
240V A.C. Mains Operation

VIDEO –	1.0 – 2.5 Vp-p Composite Video Input
	20 MHz (–3 dB) Video Bandwidth
CRT –	1000 Line Resolution
	P31 Green Screen Phosphor
	Dark Tinted – High Contrast
	Etched – Antiglare Face
MODEL	GM-1211W – P4 White Screen Phosphor
	GM1211A – PT714 Amber Phosphor Screen
	These models available at extra cost.
	Other phosphor screen types available to order.

Please contact:-

THOMAS ELECTRONICS
OF AUSTRALIA PTY. LTD.

INDUSTRIAL AND MILITARY DIVISION

HEAD OFFICE:
12 Larkin St, Riverwood NSW 2210.
Telephone (02)53 0721. Telex AA-23365.
Fax (02)534 2171.

BRANCH OFFICE:
25 Strong Ave, Thomastown Vic. 3074.
Telephone (03)460 7344.
Fax (03)460 7333.

New chip set shrinks size and cost of AT motherboards

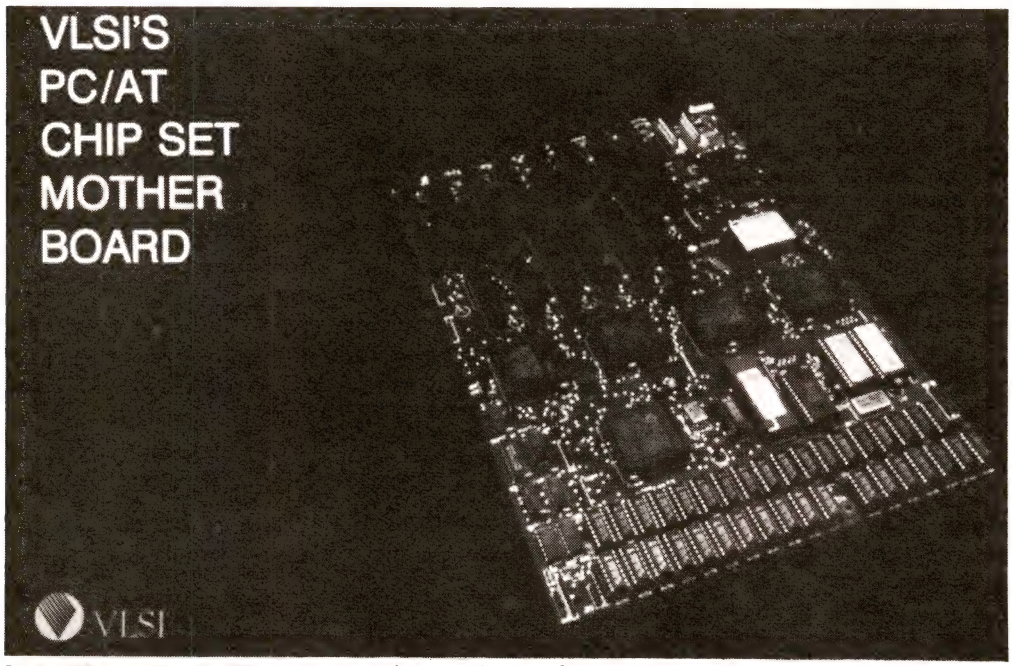
Leading US semiconductor manufacturer, VLSI Technology Inc., has released a chip set for IBM PC/AT motherboard designs that reduces the chip count from over 100 chips to less than 40 (not counting RAM), significantly reducing the board area and the final cost.

The 5-chip set, announced late last year, is now in production and is appearing in new AT motherboard designs as we go to press.

It is expected that the VLSI Technology chip set will cost some 20% less than similar chip sets from other leading IBM PC/AT replacement vendors. Further cost reductions will likely result from the reduced pc board real estate necessary to implement a fully-featured AT motherboard design.

The 5-chip set is the result of VLSI Technology's foray into application specific IC (ASIC) "megacell" development in 1986. VLSI Technology last year introduced a state machine compiler and a data path compiler, which together greatly speed the design cycle of ASICs by letting the computer do most of the time consuming gate level design work. They were the first compilers in the industry to output directly to gate arrays for "quick-turn" manufacturing.

VLSI Technology expect to release a compatible IBM PS/2 series chip set in the middle of this year. The company is represented in Australia by **Energy Control, 26 Boron St, Sumner Park 4074 Qld. (07)376 2955.**



Intelligent plotting

Schlumberger Graphics has announced their 18 Series range of high performance plotters, featuring 120 cm/second pen speeds and auto paper loading.

A 512 kbyte buffer reduces the "tie-up" time for the host computer, and a number of specific routines optimise plot speed and quality.

Plots are sequenced intelligently, in order to improve throughput, and curves are handled by dedicated standard software.

The 18 Series plotters are particularly well suited to extensive unattended plotting, due to their auto paper loading and pen exchanging features.

Graphics application packages with Benson, HPGL or HI-DM/PL vector data formats are supported. The distributors claim hardware support for all micro, minis and mainframes.

For further information, contact **Schlumberger Technologies, 140 Pacific Highway, North Sydney 2060 NSW. (02)957 2015.**

AutoCAD Expo '88

Autodesk Australia P/L is presenting the AutoCAD Expo '88 at Centrepoint, Sydney, over August 23-25.

Comprising a three-day conference, tutorial workshops and exhibition facilities, the Expo is intended for AutoCAD users, prospective users, CAD experts, application developers, trainers and students.

Autodesk will exhibit their full range of products at the Expo. They can be contacted at **PO Box 458, Richmond 3121 Vic. (03)429 9888.**

New PC interface hardware

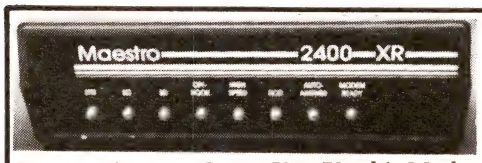
External interfacing hardware for PCs, traditionally home-brewed or hideously expensive, has become suddenly much more available with the release of Brumby Technologies' stable of data acquisition devices.

The Alpha Products AD-142 is presented as an ideal simple A/D interface, featuring eight analogue inputs each of eight bit resolution. Apart from reading voltages, the board can also interpret varying resistances, and can be expanded to accommodate further channels. Most popular PCs are supported.

The AR-139 A-Bus is an adapter card designed to allow the Commodore 64 family of computers to use the range of A-Bus interface boards.

Compatible boards in the range include analogue inputs and outputs, digital I/O, reed relays, clock/calendars and stepper motor controllers.

For further information contact **Brumby Technologies P/L, 25 McCallum St, Lakemba 2195 NSW. (02)759 1638**



The MAESTRO 2400XR Here's a fully-featured, Hayes compatible, 1200 and 2400 bps full duplex modem for just **$369 (incl. tax).**

This modem uses the LATEST in DSP Chip Set technology and microprocessor control, bringing you the future TODAY.

Super price on a Super V.22/V.22bis Modem!

Don't Wait! RING NOW!
(043) 68 2277, or (043) 68 2278.

Maestro Distributors
Calool St. Sth Kincumber 2256 NSW

008 335757 TOLL FREE MAILORDER HOTLINE FOR CREDIT CARD ORDERS!

KEY SWITCHES

	1-9	10+
Cat. S12500 ..... Normally $7.95		
1-9	10+	25+
$4.95ea	$4.25ea	$3.95ea

10 TURN WIRE WOUND POTENTIOMETER

Spectrol Model 534
¼" shaft.
Equiv (Bourns 3540S, Beckman 7256)
Dials to suit 16-1-11, 18-1-11, 21-1-11

R14050	50R	R14100	5K
R14055	100R	R14110	10K
R14060	200R	R14120	20K
R14070	500R	R14130	50K
R14080	1K	R14140	100K
R14090	2K		

1-9	10+
$9.95	$9.50

QUALITY 3mm LEDS

Cat. No. Col.	1-9	10+	100+
Z10140 Red	$0.15	$0.12	$0.10
Z10141 Grn	$0.20	$0.15	$0.12
Z10143 Ylw	$0.20	$0.15	$0.12
Z10145 Ora	$0.20	$0.15	$0.12

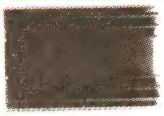
QUALITY 5mm LEDS

Cat. No. Col.	1-9	10+	100+
Z10150 Red	$0.10	$0.09	$0.08
Z10151 Grn	$0.15	$0.12	$0.10
Z10152 Ylw	$0.15	$0.12	$0.10

DIODE SPECIALS

We have millions of diodes in stock!

1-99	+	100+	1000+
IN4148 Small signal Cat. Z10135			
3¢		2½¢	2¢
IN4004 400V 1A Cat.Z10107			
4¢		3½¢	3¢



HIGH EFFICIENCY RADIAL FIN HEATSINK

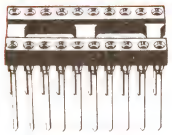
Black anodised with a thick base plate, this radial fin heatsink can dissipate large amounts of heat for maximum efficiency.
Designed by Rod Irving.

H10520	105 x 30mm	$ 3.50
H10525	105 x 75mm	$ 4.95
H10529	105 x 100mm	$ 5.50
H10534	105 x 140mm	$ 7.90
H10535	105 x 150mm	$ 8.90
H10538	105 x 170mm	$ 9.95
H10542	105 x 195mm	$10.95
H10543	105 x 200mm	$10.95
H10546	105 x 225mm	$11.95
H10549	105 x 300mm	$12.95
H10560	105 x 600mm	$26.95

HIGH INTENSITY RED LED BAR GRAPH

Dimensions:
Overall: 63mm across, 5mm high.
LEDs: 10 x 5mm x 1mm

Cat.No.	1-9	10+
Z10180	$2.95	$2.75



WIRE WRAP IC SOCKETS

These quality 3 level wire wrap sockets are tin-plated phosphor bronze.

Cat.No.	Description	1-9	10+
P10579	8 pin	$1.50	$1.40
P10580	14 pin	$1.85	$1.70
P10585	16 pin	$1.95	$1.80
P10587	18 pin	$1.95	$1.80
P10590	20 pin	$2.95	$2.70
P10592	22 pin	$2.95	$2.70
P10594	24 pin	$3.95	$3.50
P10596	28 pin	$3.95	$3.50
P10598	40 pin	$4.95	$4.50

ELECTRET MIC INSERTS

With pins for easy board insertion.
Cat. C10170

1-9	10+	100+
$1.20	$1.00	$0.90

THIS MONTH ONLY!

RCA GOLD PLATED PLUGS AND SOCKETS

For those who need the ultimate in connection. Essential for laser disc players to get that fantastic sound quality.

Plug Cat. P10151	$2.95
Socket Cat. P10150	$2.25

WELLER WTCPN SOLDERING STATION

The WTCPN Features:
- Power Unit 240 V AC
- Temperature controlled iron, 24 V AC
- Flexible silicon lead for ease of use
- Can be left on without fear of damaged tips!

The best is always worth having.
Cat. T12500 ..... R.R.P. $149
SPECIAL, ONLY $129

NICADS!

Save a fortune on expensive throw away batteries with these quality Nicads and Rechargers!

Size	Desc.	1-9	10+	100+
AA	450 mA.H.	$2.95	$2.75	$2.50
C	1.2 A.H.	$9.95	$9.50	$8.95
D	1.2 A.H.	$9.95	$9.50	$8.95

SUPER DELUXE BATTERY CHARGER

- Charges from 1 to 10 D, C, AA, AAA, N, and up to 3 x 9V batteries at the same time.
- Dual colour LED in first three compartments to designate 1·5V or 9V.
- 240V AC/50Hz.
- Approval No. N10637

Cat.M23525 ..... $59.95

ROD IRVING ELECTRONICS IS AUSTRALIA'S COMPLETE ELECTRONICS STORE.

TRIGGER TRANSFORMERS

Cat. M10104 ..... $1.45

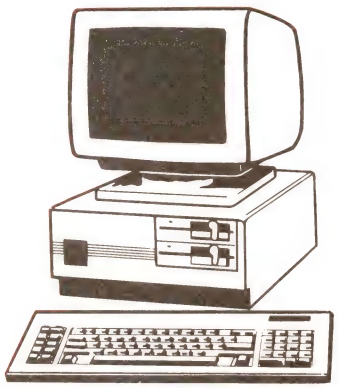
METEX 3800 MULTIMETER

This instrument is a compact, rugged, battery operated, hand held 3½ digit multimeter for measuring DC and AC voltage, DC and AC current. Resistance and Diode, for testing Audible continuity and transistor hFE. The Dual-slope A-D Converter uses C-MOS technology for auto-zeroing, polarity selection and over-range indication. Full overload is provided. It is an ideal instrument for use in the field, laboratory, workshop, hobby and home applications.

Features...
- Push-button ON/OFF power switch.
- Single 30 position easy to use rotary switch for FUNCTION and RANGE selection.
- ½" high contrast LCD.
- Automatic over-range indication with the "1" displayed.
- Automatic polarity indication on DC ranges.
- All ranges fully protected plus Automatic "ZERO" of all ranges without short circuit except 200 ohm Range which shows "000 or 001"
- High Surge Voltage protection 1.5 KV-3 KV.
- Diode testing with 1 mA fixed current.
- Audible Continuity Test.
- Transistor hFE Test.

SPECIFICATIONS
Maximum Display: 1999 counts 3½ digit type with automatic polarity indication.
Indication Method: LCD display.
Measuring Method: Dual-slope in A-D converter system.
Over-range Indication: "1" Figure only in the display.
Temperature Ranges: Operating 0-C to +40-C
Power Supply: one 9 volt battery (006P or FC-1 type of equivalent)

Cat. Q91530 **Normally $109**
SPECIAL $79



BABY AT* COMPATIBLE COMPUTER! FROM $2,095

- Final assembling and testing in Australia!
- 1 M/Byte Main Board
- Switchable 8/10/12 MHz
- 1.2 M/Byte Floppy Disk Drive
- 80286 CPU
- Colour Graphics Display Card
- 8 Slots
- Floppy & Hard Disk Controller
- Printer Card and RS232
- Keyboard
- 200W Power Supply
- Manual
- 6 Months Warranty
- Dimensions: 360(W) x 175(H) x 405(D)mm

SHORT BABY AT* 512K RAM... **$2,095**

STANDARD BABY AT* 640K RAM, hard disk drive....
WITH 20 M/BYTE HARD DISK **$2,895**
WITH 40 M/BYTE HARD DISK **$3,495**
WITH 80 M/BYTE HARD DISK **$4,395**

DIECAST BOXES

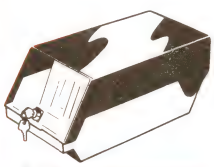
Diecast boxes are excellent for RF shielding, and strength.
Screws are provided with each box.

H11451	100 x 50 x 25mm	$ 5.95
H11452	110 x 60 x 30mm	$ 6.50
H11453	120 x 65 x 40mm	$ 6.95
H11461	120 x 94 x 53mm	$11.50
H11462	188 x 120 x 78mm	$13.50
H11464	188 x 188 x 64mm	$29.50

CORDLESS RECHARGEABLE SOLDERING IRON

- Built in solder point illumination
- Easy replacement of solder tip
- Protective stand which also functions as charging unit
- Sponge pad attach to stand
- Plug pack power adaptor
- Includes Nicad battery
- Instruction manual
- 12 months warranty

Cat. T12480 ..... Normally $79.95
SPECIAL, $69.95



5¼" DISK STORAGE (DD100-L)

Efficient and practical. Protect your disks from being damaged or lost!
Features...
- 100 x 5¼" disk capacity
- Smoked plastic hinged lid
- Lockable (2 keys supplied)
- High impact ABS plastic base.
- Contemporary design

C16020 ..... **only $17.95**

DB25 CONNECTOR SPECIALS!

We have just imported 50,000.
So you get to save a small fortune!

DB25 MALE (P10900)

1-9	10+	100+
$1.00	$0.90	$0.80

DB25 FEMALE (P10901)

1-9	10+	100+
$1.20	$1.00	$0.90

CANNON TYPE CONNECTORS

1-9	10+
P10960 3 PIN LINE MALE.	
$3.90	$3.50
P10962 3 PIN CHASIS MALE	
$3.00	$2.50
P10964 3 PIN LINE FEMALE	
$4.50	$3.90
P10966 3 PIN CHASIS FEMALE	
$4.95	$3.95

"NO BRAND" DISKS!!

Now you can buy absolute top quality disks that are also the cheapest in Australia! They even come with a lifetime warranty! So why pay 2-3 times the price for the same quality?

Packs of 10, D/S D/D without boxes, or brand name, just their white paper jacket, and index labels. (5¼" disks includes write protects).

5¼" "NO BRAND" DISKS
DOUBLE SIDED/DOUBLE DENSITY

10+DISKS	100+DISKS	1,000+DISKS
$8·95ea	$8·50ea	$7·80ea

(ALL PRICES PER 10 DISKS)

3½" "NO BRAND" DISKS
DOUBLE SIDED/DOUBLE DENSITY

10+DISKS	100+DISKS	1,000+DISKS
$27	$26	$24

(ALL PRICES PER 10 DISKS)

Rod Irving Electronics

MELBOURNE: 48 A'Beckett St. Phone (03) 663 6151
NORTHCOTE: 425 High St. Phone (03) 489 8866
CLAYTON: 56 Renver Rd. Phone (03) 543 7877
SOUTH AUSTRALIA: Electronic Discounters P/L, 305 Morphett St, ADELAIDE Phone (08) 212 1799
NOTE: Prices may vary interstate due to freight costs.

MAIL ORDER:
Local Orders: (03) 543 7877
Interstate Orders: (008) 33 5757
All Inquiries: (03) 543 7877

CORRESPONDENCE:
P.O. Box 620, CLAYTON 3168
Telex: AA 151938
Fax: (03) 543 2648

MAIL ORDER HOTLINE
008 335757
(TOLL FREE)
(STRICTLY ORDERS ONLY)

LOCAL ORDERS & INQUIRIES
(03) 543 7877

POSTAGE RATES:

$1 - $9.99	$2.00
$10 - $24.99	$3.00
$25 - $49.99	$4.00
$50 - $99.99	$5.00
$100 - $199	$7.50
$200 - $499	$10.00
$500 plus	$12.50

The above postage rates are for basic postage only. Road Freight, bulky and fragile items will be charged at different rates.

All sales tax exempt orders and wholesale inquiries to: RITRONICS WHOLESALE, 56 Renver Rd, Clayton. Ph. (03) 543 2166 (3 lines)

Errors and omissions excepted. Prices and specifications subject to change.

IBM® PC® XT® AT® are registered trademarks of International Business Machines. *Apple is a registered trademark. *Denotes registered tradmarks of their respective owners.

MasterCard VISA

008 335757 TOLL FREE MAILORDER HOTLINE FOR CREDIT CARD ORDERS! LOCAL ORDERS & INQUIRIES CALL (03) 543 7877

A Real Time Clock for your Computer for Under $50?

YOU'RE KIDDING!

This nifty little device resides under an existing EPROM or ROM in you IBM/PC or compatible and adds the convenience of a real time, battery backed clock, cheaply.

Simple to install, just like installing an IC, the Smartwatch does not use up an expansion card slot in your PC, allowing you to use it for other equipment. The device is housed in a standard 28-pin DIP, piggy-back socket, fits under any standard BIOS ROM or other EPROM in the computer and is totally transparent to any other devices. It comes complete with a floppy disk containing installation software,

Full details are available in the February 1988 edition of AEM, giving complete installation and operational details.

Offer extended till 30th JUNE 1988, but HURRY!

LAST CHANCE!

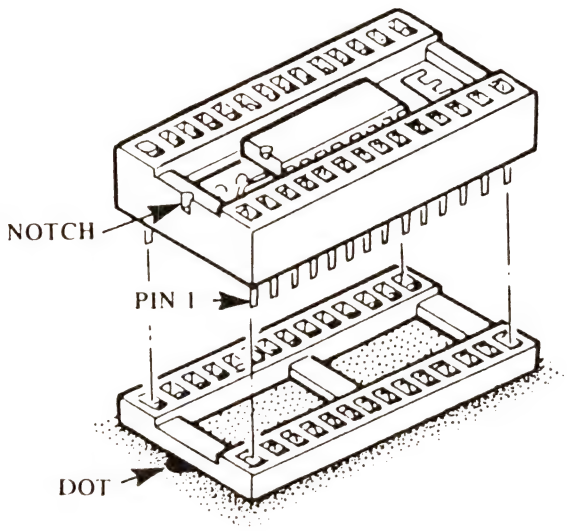
Send mail orders to:

AEM Smartwatch Offer,
1st Floor, 347 Darling St,
BALMAIN 2041 NSW.

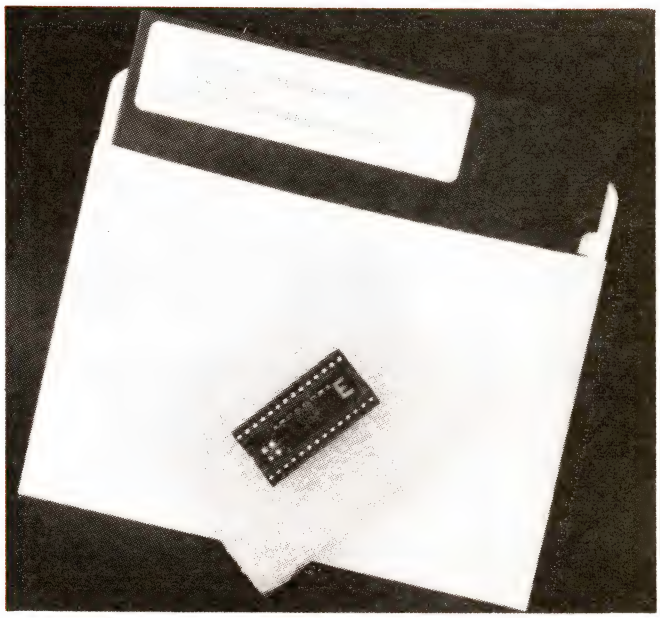
or phone (02)555 1677 and "pledge your plastic".

THE XE1216E SMARTWATCH JUST PLUGS INTO ANY ROM SOCKET ON YOUR MOTHERBOARD. THE ROM PLUGS BACK IN ON TOP OF THE XE1216E MODULE.

(Not suitable for use in compatibles where an RTC is already included on the motherboard. e.g: Amstrad PC1640).



By special arrangement with the importers, Energy Control, we are able to offer readers the opportunity of obtaining this product at a special price as an introductory offer. This offer is made by Energy Control and the magazine is acting as a clearing house for orders.



THE XE1216E "SMARTWATCH" BY XECOM
AS SIMPLE AS INSTALLING AN IC!

PLEDGE YOUR PLASTIC over the phone, or complete the coupon TODAY!

Please send me . . . . XE1216E Smartwatch Module(s) as described in the Feb. '88 edition of AEM.

$49.95 each, plus $8.00 delivery fee. (including sales tax).

I am paying by:
☐ Cheque ☐ Money Order ☐ Credit Card

Cheque No: . . . . . .

Money Order No: . . . . . .

* Make cheques or money orders payable to "AEM Offers Account."

My credit card type is:
☐ Bankcard ☐ Mastercard ☐ Visa

Card No: . . . . . .

Signature: . . . . . .
* Unsigned credit card orders cannot be accepted.

Name: . . . . . .

Address: . . . . . .

. . . . . P/Code: . . . . .
(Orders are despatched to Energy Control within 24 Hours of receipt at AEM).

One mouse is the same as another. Right? Not the "Dicky Mouse"!

The mouse has become the standard computer "tool" for so much software, particularly graphics oriented software. If you've ever had to use one regularly, then you'll be aware of just how useful they are – and their limitations!

RECENTLY, Dick Smith Electronics released a mouse bundled with a package of useful software. It wasn't the software that excited our interest so much as the mouse that come with it. Dubbed the PC Mouse, it featured an optical method of movement and position sensing, rather than the common electro-mechanical system. As the movement of the mouse is sensed optically, the mouse has NO moving parts, reducing the adverse effects wear and tear on the equipment and considerably enhancing the precision of the instrument, according to the press release which brought it to our attention.

Firstly, let me explain how the two mouse mechanisms operate. In the mechanical system, a weighted rubber ball is recessed in the underside body of the mouse and, as the mouse is moved across a surface, the ball spins operating, in turn, two orthogonally mounted "axles" which are linked to either an optical or mechanical motion detecting system. These two sensors then provide a series of pulses to the computer's input port to which it is linked. The software looks at the port and manipulates a cursor, or whatever, on the screen.

In the all-optical system, the mouse resides on a metallic "grid pad" which has finely spaced, reflective lines running both horizontally and vertically across the pad. Actually, it has a matrix of non-reflective squares "printed" on the reflective surface, the space between the squares forming the rows and columns of reflective lines.

Inside the 'gut' of the mouse are two LEDs – in this case, one red LED and one infra-red (IR) LED. One of these detects horizontal, or x-axis, movement across the pad, and the other senses vertical, or y-axis, movement across the pad. The LEDs are powered from the computer's serial port and the light from each is reflected off the metallic pad, back into the body of the mouse where the light is sensed by a photodetector.

Therefore, as the mouse passes over the lines on the pad the pulses from the photodetectors provide an indication of the direction and speed of the mouse's movement, i.e: it detects the *velocity at which you move the mouse. The software translates this into similar motion of a cursor or whatever on the computer's screen.*

Why a mouse?

All very complicated you might say. Well, described like that, yes. However, on a more fundamental scale the common-or-garden computer mouse fills a gap in the area of inputting data to the computer. This is because it inputs a signal to the computer which represents a vector quantity to you and me, that is: a magnitude of movement (speed), distance and the direction of movement.

Thus, the mouse goes one further than the joystick in terms of inputting data. Whereas the joystick only senses direction, the mouse provides the computer with direction, speed and distance.

What practical good does that do for the user? Well, in the world of personal computers the movement of an object across a two-dimensional surface, such as the arrangement for a mouse, is the most natural method of transferring or controlling cursor motion on a computer screen. In other words, you can make the cursor mimic your own hand movement. Witness the success of the Apple Mac.

The mouse is especially useful for graphics oriented software such a sketchpad programs like PC Paint, GEM Paint, etc. As a matter of fact, to really run the mouse through its paces we used it with our CAD draughting system, replacing the expensive digitizer which we normally use. We started out installing it on what was then our current version of AutoCAD, running on an IBM XT. Sometime later we obtained AutoCAD V.9 for review (look for it in an upcoming issue) which we installed on a locally available bolt-together AT clone, and installed the "Dicky" mouse along with it.

We found the optical mouse to be more accurate, more versatile, and easier to use than the highly-priced digitizer we were using, which requires about three times the work area and cost some six times the price of the mouse and its software bundle!

Evaluation

In use, I found the PC Mouse from Dick Smith Electronics a pleasure to use, especially after my few, short-lived encounters with the mechanical kind. This remarkable rodent glides across its smooth metal pad on two,

– continued on p.44. ▷

The "Superbis" modem

Part 2 – Construction details

Roy Hill

Last month we introduced the sophisticated Maestro 2400ZXR "Superbis" modem, with full-featured microprocessor control. In this article we outline in detail the precise sequence of steps for construction of this gem.

THIS PROJECT is considerably more advanced than the original Supermodem (AEM4610), in that the board has far greater track density and overall functionality than the Supermodem in a unit approximately one half the size. This means that track spacings are quite close, so you **must have a fine-tipped soldering iron.** One suitable for fine pc board work will do well. The tip of the iron must also be well earthed, as there are several CMOS components on this board. Note that normal CMOS precautions should be taken when handling the chips and installing them.

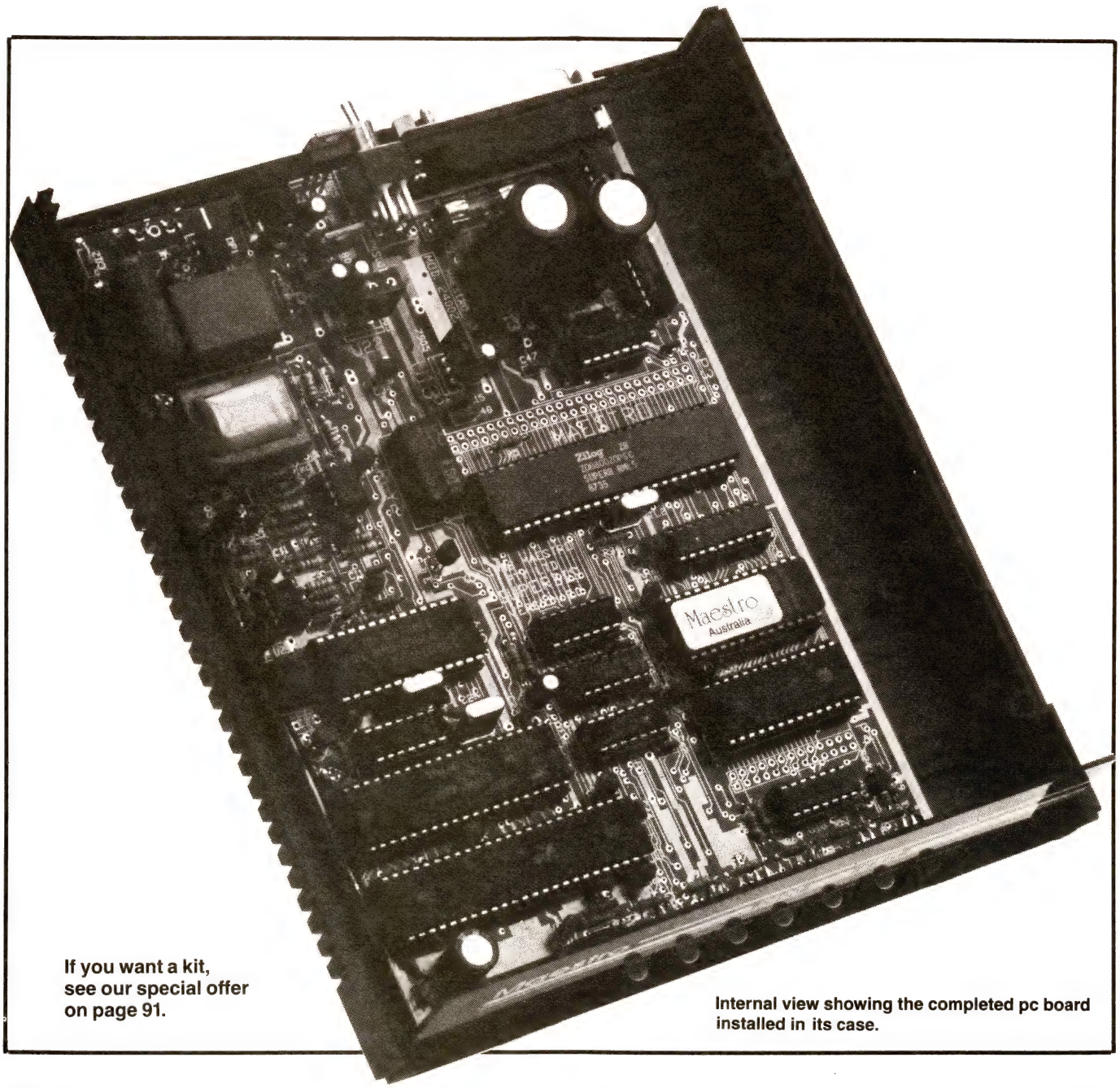
As this board is more complicated than the original Supermodem kit, potential constructors should evaluate their ability to successfully construct the project. If you feel that it is beyond your capabilities, please return the board to Maestro for a refund. A fully built version is available from Maestro for $399.

Check off all the components against the parts list, so that you'll know when you are finished that any left-over parts are NOT left-overs!

Prior to attempting any construction work, a visual and multimeter check of the circuit board is necessary. Check the power rails in particular, for short circuits. The analogue supply should also be checked for shorts. Also check for continuity of the bipolar power supply to the relevant pins of the XR2401 DSP chip. These are pin 1 (+5 V analogue – VCCA) and pin 48 (–5 V analogue – VDDA). You should also check that the supplies (that is, the analogue and digital, negative and positive supplies) are not cross connected. The separation of these two power rails is vital for the efficient operation of the board.

You will need all the normal construction aids – 0.71 mm 60/40 solder, magnifying glass, side cutters, de-soldering braid (we hope you don't need it) and a clean bench with good lighting. Construction of this board will proceed in stages, with testing procedures carried out on the completion of each stage. **It is absolutely vital that all steps are performed sequentially.** Do not take any short cuts, as you may ruin your project. Above all, be patient, methodical and check your work at stages. Take frequent breaks (have a walk or make some coffee). This project will take the best part of a day, so allow adequate time for testing as well.

Construction will proceed slightly differently to normal – we will be constructing (and testing) the board in two separate stages. The first stage is the Super8 processor and its associated circuitry and the second stage is the remainder of the circuit, including the Telecom side and the Exar Chip Set. Please ensure that you follow the instructions religiously – do not install any more components than shown in each of the steps. ▷



If you want a kit, see our special offer on page 91.

Internal view showing the completed pc board installed in its case.

STEP 1

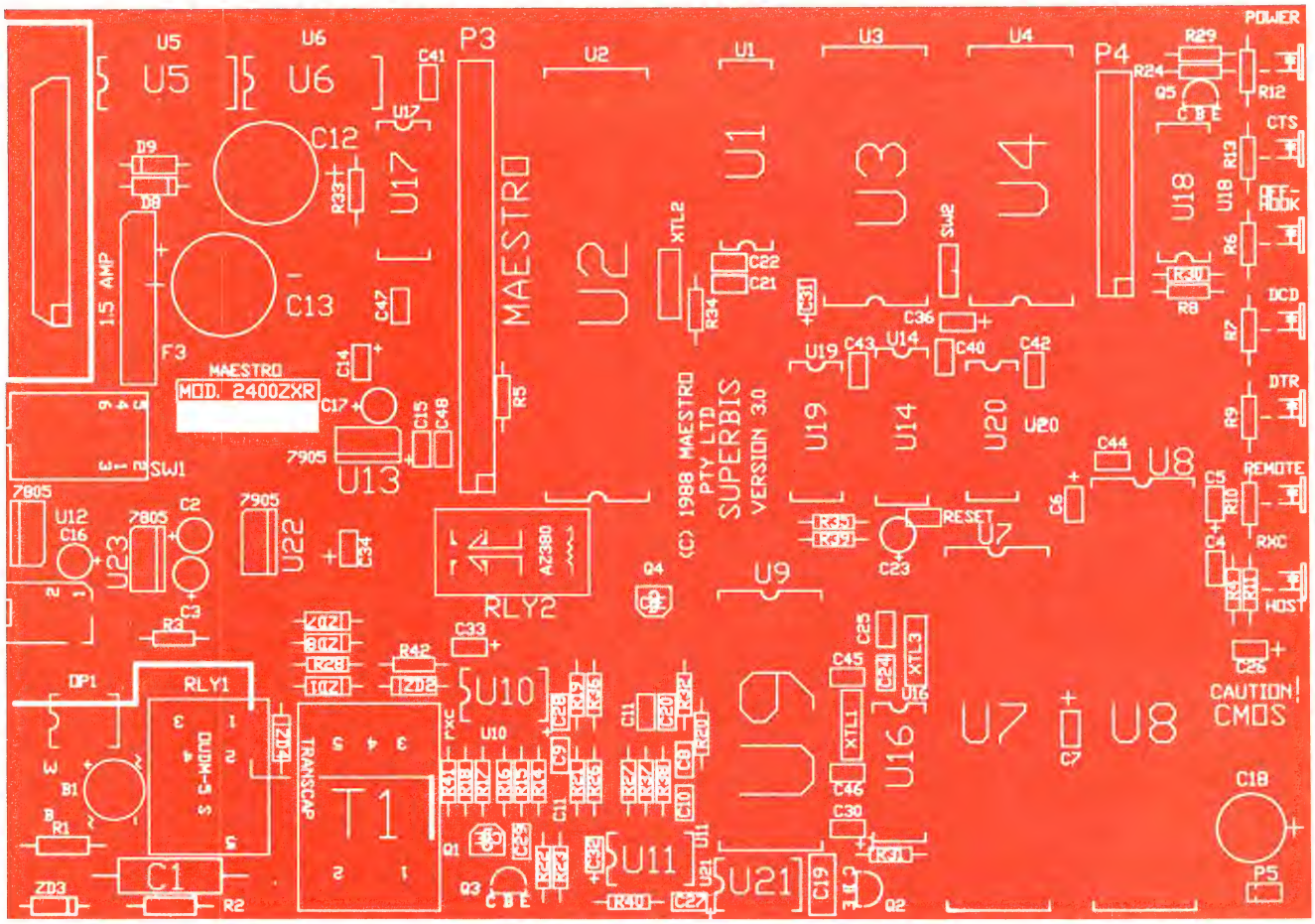
The first part of the construction will be the processor section, involving the Super8 and its support circuitry. Install the sockets for ICs 1, 2, 3, 4, 5, 6, 14, 17, 18, 19 and 20. Note that instead of a single 48-pin socket for U2 (IC2), there are two stackable 24-pin sockets (U8 also requires 2 x 24-pin stackable sockets). Tack each opposing corner with solder and re-check the orientation of the sockets, with respect to the overlay diagram. This is your last chance to correct any orientation mistakes prior to soldering all of the pins.

Note also that if you elected to purchase the battery-backed version of the board, U4 will be a "Smart Socket" instead of a normal 28-pin socket. A Smart Socket contains an integral Lithium battery, which lasts for about seven years. After soldering all the pins, hold the board up to the light to check for any missed pins. One of the most likely places for faults is socket pins that have not been soldered – particularly pins 1, 7, 14 and 28.

STEP 2

Install and solder the ceramic bypass capacitors (C10, 40-44 inclusive, 47 and 48) and the tag tantalums. These are C5, 6, 7, 14, 15, 20, 26, 27, 28, 30, 31, 32, 33, 34 and 36. Note particularly the orientation of the tag tantalums – they are polarised. Next, install the electrolytics (C2, 3, 16, 17 and 23 are 10 uF/25 V electrolytics and C12 and 13 are 2200 uF/25 V electrolytics).

Install and solder the DB25S right-angle socket, the switch, the fuse-holder, the two power diodes (D8 and D9), XTL2 (19.6608 MHz HC18 can type – **with insulated base),** SW2 (a three-pin jumper) and the power connector. Install and sol- ▷



Component overlay, showing placement of the components. The trackwork is not shown here for the sake of clarity – it's a very dense board! The pc boards supplied with kits are solder masked both sides and have a silk-screened component overlay as shown here.

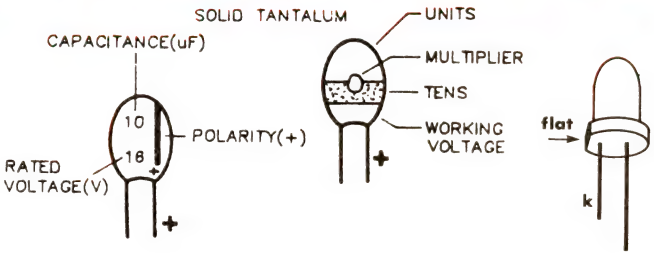
der the LEDs (the red one is for power.) Note the shorter lead – the cathode – is marked with a "–" sign on the overlay. The lead length of the LEDs should be EXACTLY 12.5 mm from the mounting hole to the base of the LED. Install the two driver capacitors for the crystal (C21 and 22 – 15 pF) and the resistor for the driver circuit (R34 – 1M5).

STEP 3

Now we have to install and solder all of the three- terminal regulators, **with the exception of U12.** Note that U12 (the digital 7805 regulator) is screwed to the back panel for heatsinking. Remove the screws from the DB25 connector, place the back panel in position and position the 7805 regulator. Solder it into the correct position. Install and solder the LED current limiting resistors (R6, 7, 9, 10, 11, 12 and 13 – 330R), R5, 8, 29, 30, 35 and 39 (4k7 resistors) and R24 (2k2). Solder transistor Q5 in place, as this is used to drive one of the LED lines. Now for some testing.

STEP 4

Apply power to the board and, with a multimeter set for ac milliamps, measure the current drain by connecting the multimeter across the fuse holder (with no fuse inserted). It should be less than 20 milliamps. If the drain is in excess of this figure, immediately disconnect the power and check all the soldering and the orientation of the components.



LEVEL

We expect that constructors of an

INTERMEDIATE

level, between beginners and experienced persons, should be able to successfully complete this project.

The printed circuit board is double-sided with plated- through holes and impossible to make with the usual facilities available to hobbyists, so the artwork is not reproduced here. Maestro has also retained copyright on the artwork.

When all is OK, disconnect the power and install all of the ICs for which you have soldered in sockets. Attach a serial cable from your computer to the DB25 socket and re- apply power. Fire up your favourite comms package and set the baud rate to 2400. Type in **ATG** followed by a carriage return (this takes you into the advanced operating system) and then type **TEST** followed by a carriage return. If everything in the ▷

AEM4624 SUPERBIS MODEM PARTS LIST(C)

Semiconductors

B1 ..... WO4 bridge rect.
D8, D9 ..... 1N4004
LED1 ..... 5 mm red LED
LED2-7 .... 5 mm yellow LED
OP1 ..... 4N25 opto-isolator
Q1,Q4 ..... 2N3904
Q2,3,5 ..... BC548
U1 ..... 74LS373
U2 . Z0880020P (Super8 CPU)
U3 ..... 27C256
U4 6264
U5 1489
U6,U17 1488
U7 ..... XR2401 V.22 modem
U8 ..... XR2402 V.22 modem
U9 .. EF7910 V.21/V.23 modem
U10 1458
U11 ..... TLO81
U12,U23 7805
U13,U22 7905
U14 ..... 74HC153
U15 ..... not used
U16 ..... 74LS08
C29 ..... 150p ceramic
C35,37,38,39 ..... not used
C45,46 ..... 22p ceramic

NOTE: C19 MAY be used for increasing the gain of the speaker amplifier – try a 100n (0.1 uF) value, if required.

Resistors all ¼ W, unless specified

R1 ..... 100R, 1 W
R2,20 ..... 100R
R3,23 ..... 47k
R4 ..... 100k
R5,8,21,22,29,30,39 .... 4k7
R14,35,37,38 ..... 10k
R6,7,9-13 ..... 330R
R15,32 ..... 20k
R16 ..... 560R
R18 ..... 22k
R19,24,31,36,41 ..... 2k2
R25 ..... not used
R26 ..... 1k
R27 ..... 510R
R28 ..... 270R
R33 ..... 1R2, 1 W
R34 ..... 1M5
R40 ..... 15k
R42 ..... 560R
U18 7407
U19 ..... 74HC14
U20 ... 74HC32 – must be HC
U21 ..... LM386
ZD1,2,7,8 ..... 3V3 zeners
ZD3 ..... 9V1 zener
ZD4 ..... 5V1 zener
ZD5,ZD6 ..... not used

NOTE: 74HCxxx and 74LSxxx parts may be used interchangeably, except for U20.

Capacitors

C1 ..... 1u5/250 V
C2,3,16,17 ... 10u/25 V electro.
C4 .... 100n (0.01 uF) ceramic
C5-7,14,15,26-28, 30-34,36 ... 2u2/35 V tag tant.
C8 ..... 2n2 ceramic
C9 ..... 10p ceramic
C10,21,40-44, 47,48 ..... 100n ceramic
C11 ... 220n (0.22 uF) ceramic
C12, 13 .. 2200u/25 V electro.
C18 ..... 220u/16 V electro.
C19 ..... see note
C20 ..... not used
C21,22,24,25 .... 15p ceramic
C23 ..... 33u/25 V electro.

Miscellaneous

SW1 ..... DPDT pc mount toggle switch.
T1 ... Transcap 600/600 Ohm line transformer.
RLY1 ..... type OUDM-5S.
RLY2 ..... type AZ830.
XTL1 ..... 2.4576 MHz (HC18 can type).
XTL2,3 ..... 19.6608 MHz (HC18 can type).

2400ZXR pc board; 1 x right angle DB25 socket; 1 x fuse M205/1.5A; 2 x fuse clips; 1 x Tele line cord – 2-conductor; IC sockets – 3 x -pin, 7 x 14-pin, 1 x 16-pin, 4 x 24-pin, 3 x 2-pin, 1 x 40-pin; 1 x coax power connector; 1 x 2-pin plug pack power connector; 1 x 3- pin jumper (SW2); 1 x 2-pin jumper (P5); 2 x Utilux pins (spade lugs for line connection); 1 x length coax trace; solder, tools, magnifying glass, side cutters, desoldering braid, etc.

Kit cost: $349

firmware is operating correctly, the modem will respond with **OK.**

Before we go any further, check the analogue supply rail to determine the presence of the positive and negative rails for the DSP chip (VCCA and VDDA on the circuit diagram).

STEP 5

Install and solder the remaining sockets and the opto-isolator (OP1). Note that this component does not have a socket – it's soldered directly to the board. Solder in the relays and the bridge rectifier. Install and solder the remaining transistors, the remaining capacitors (including the isolation capacitor), the remaining resistors and the zener diodes. Now solder in the isolation transformer, the Telecom plugs (at the far left front of the board). At this stage, construction is nearly complete.

STEP 6

A coax trace is provided to enable the Rx Data to bypass the digital portion of the circuit. One end of the trace should be connected to the Rx point on the far right hand mid-front of the board. Solder the shield to the small rectangular solder pad located immediately beside the Rx entry pad. Take the trace along the *outside of the board* (the front) to the connection point near the isolation transformer. It is only necessary to connect the centre core at this point. **DO NOT TAKE THE SHORTEST ROUTE OVER THE CENTRE OF THE BOARD.**

The whole idea of this trace is to provide a noise free path for the incoming signal. The only way to do this is to keep it well away from the digital portion of the circuit (with all its switching spike noise).

Congratulations!

It's done. Check to ensure that components have not been omitted. Please don't blithely carry on if there are several resistors/capacitors etc left over. Check carefully with the parts list to ensure that all components have been accounted for.

Next month, we will continue with trouble-shooting and diagnostics. The final article will discuss the use of the firmware and driving the modem from a comms package.

DIRECT-CONNECT MODEMS AND YOUR RESPONSIBILITIES

Any device which you intend to connect to a Telecom line must be 'type-approved' as an attachment. It is an offence under the Telecommunications Act 1975 to attach any apparatus to a telephone line which is part of the public switched telephone network other than an approved device or an appliance leased from Telecom.

You are at perfect liberty to construct and use the modem described here over, for example, an internal building intercom line or other private 'twisted pair' line, or with a packet radio terminal node controller (TNC).

The electrical, electronic and physical design and layout of the project has been done to comply with relevant type-approval specifications and for electrical safety. In particular, the mains and line transformers both comply with Australian Standard AS3126, and Telecom typed-approved line transformers have been specified in the parts list.

The Telecom specifications relating to this sort of equipment include documents 1050, 1053, 1222, 1240, 1302 and 1364. Authorization for type approval must be made on Telecom's Form TS139 "Data and Non-Voice Equipment Directly Connected to the Telecom Network"

Zilog

Super8™ MCU ROMless, ROM, and Prototyping Device with EPROM Interface

Product Specification

Z8800, Z8820, Z8822

FEATURES

- Improved Z8® instruction set includes multiply and divide instructions, Boolean and BCD operations.
- Additional instructions support threaded-code languages, such as "Forth."
- 325 byte registers, including 272 general-purpose registers, and 53 mode and control registers.
- Addressing of up to 128K bytes of memory.
- Two register pointers allow use of short and fast instructions to access register groups within 600 nsec.
- Direct Memory Access controller (DMA).
- Two 16-bit counter/timers.
- Up to 32 bit-programmable and 8 byte-programmable I/O lines, with 2 handshake channels.
- Interrupt structure supports:
  - 27 interrupt sources
  - 16 interrupt vectors (2 reserved for future versions)
  - 8 interrupt levels
  - Servicing in 600 nsec. (1 level only)
- Full-duplex UART with special features.
- On-chip oscillator.
- 12 MHz/20 MHz clock.
- 8K byte ROM for Z8820

GENERAL DESCRIPTION

The Zilog Super8 single-chip MCU can be used for development and production. It can be used as I/O- or memory-intensive computers, or configured to address external memory while still supporting many I/O lines.

The Super8 features a full-duplex universal asynchronous receiver/transmitter (UART) with on-chip baud rate generator, two programmable counter/timers, a direct memory access (DMA) controller, and an on-chip oscillator.

The Super8 is also available as a 48-pin and 68-pin ROMless microcomputer with four byte-wide I/O ports plus a byte-wide address/data bus. Additional address bits can be configured, up to a total of 16.

Protopack

This part functions as an emulator for the basic microcomputer. It uses the same package and pin-out as the basic microcomputer but also has a 28-pin "piggy back" socket on the top into which a ROM or EPROM can be installed. The socket is designed to accept a type 2764 EPROM.

This package permits the protopack to be used in prototype and final PC boards while still permitting user program development. When a final program is developed, it can be mask-programmed into the production microcomputer device, directly replacing the emulator. The protopack part is also useful in situations where the cost of mask-programming is prohibitive or where program flexibility is desired.

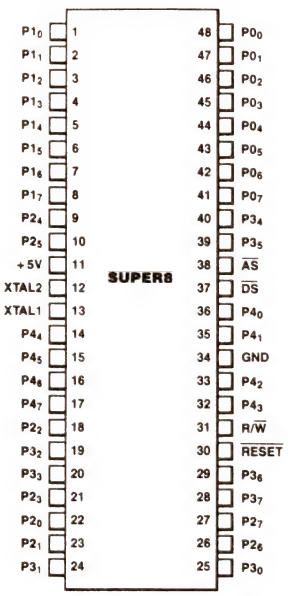


Figure 1b. Pin Assignments — 48-pin DIP

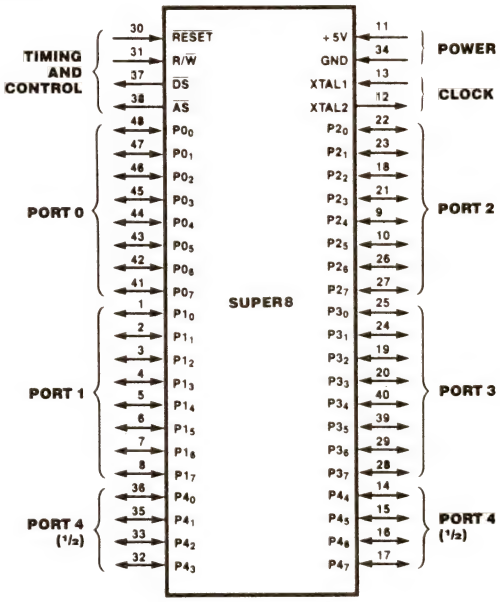


Figure 2. Pin Functions

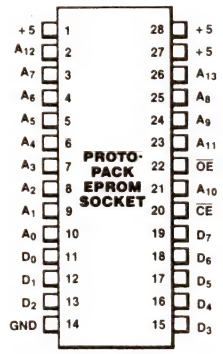


Figure 3. Pin Assignments 28-Pin Piggyback Socket

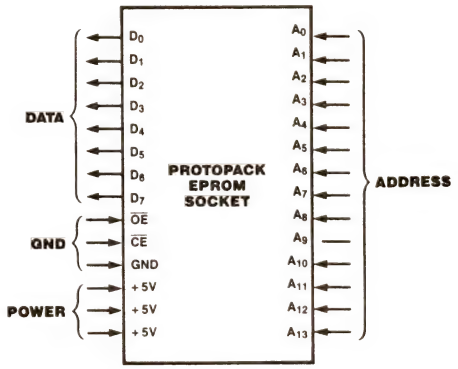


Figure 4. Pin Functions 28-Pin Piggyback Socket

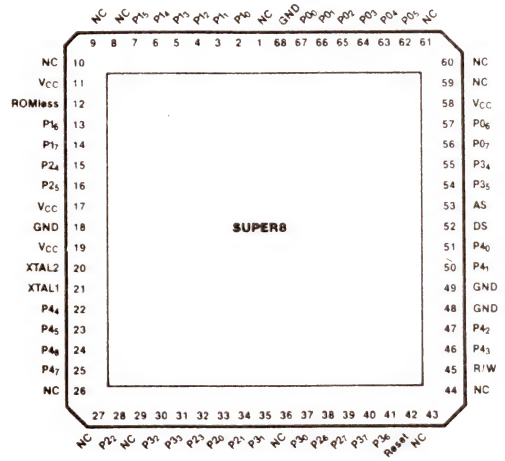


Figure 1a. Pin Assignments — 68-pin PLCC

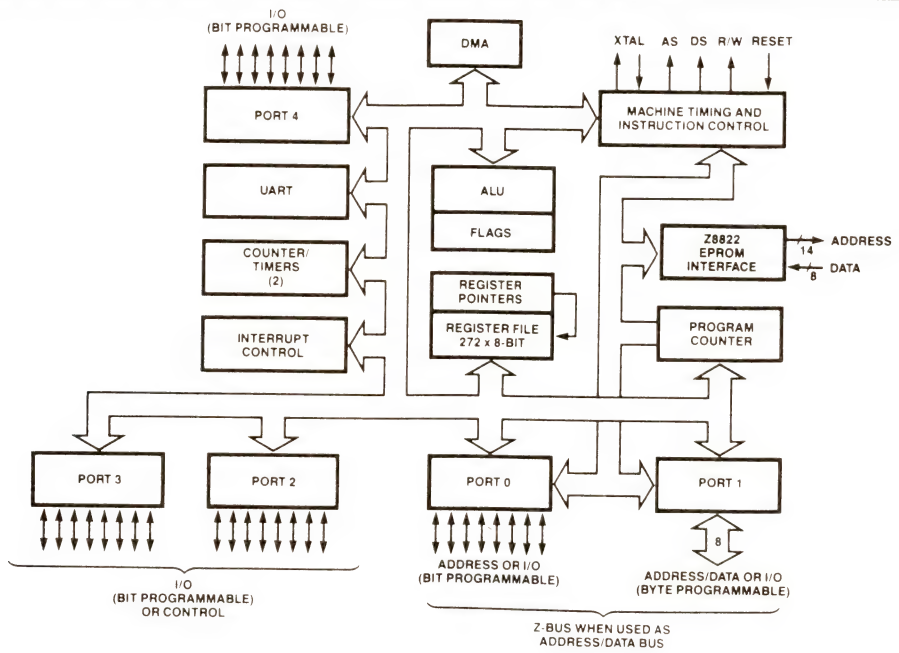


Figure 5. Functional Block Diagram

ARCHITECTURE

The Super8 architecture includes 325 byte-wide internal registers. 272 of these are available for general purpose use; the remaining 53 provide control and mode functions.

The instruction set is specially designed to deal with this large register set. It includes a full complement of 8-bit arithmetic and logical operations, including multiply and divide instructions and provisions for BCD operations. Addresses and counters can be incremented and decremented as 16-bit quantities. Rotate, shift, and bit manipulation instructions are provided. Three new instructions support threaded-code languages.

The UART is a full-function multipurpose asynchronous serial channel with many premium features.

The 16-bit counters can operate independently or be cascaded to perform 32-bit counting and timing operations. The DMA controller handles transfers to and from the register file or memory. DMA can use the UART or one of two ports with handshake capability.

The architecture appears in the block diagram (Figure 5).

PIN DESCRIPTIONS

The Super8 connects to external devices via the following TTL-compatible pins:

$\overline{AS}$. *Address Strobe* (output, active Low). $\overline{AS}$ is pulsed Low once at the beginning of each machine cycle. The rising edge indicates that addresses R/$\overline{W}$ and $\overline{DM}$, when used, are valid.

$\overline{DS}$. *Data Strobe* (output, active Low). $\overline{DS}$ provides timing for data movement between the address/data bus and external memory. During write cycles, data output is valid at the leading edge of $\overline{DS}$. During read cycles, data input must be valid prior to the trailing edge of $\overline{DS}$.

$P0_0$-$P0_7$, $P1_0$-$P1_7$, $P2_0$-$P2_7$, $P3_0$-$P3_7$, $P4_0$-$P4_7$. *Port I/O Lines* (input/output). These 40 lines are divided into five 8-bit I/O ports that can be configured under program control for I/O or external memory interface.

In the ROMless devices, Port 1 is dedicated as a multiplexed address/data port, and Port 0 pins can be assigned as additional address lines; Port 0 non-address pins may be assigned as I/O. In the ROM and protopack, Port 1 can be assigned as input or output, and Port 0 can be assigned as input or output on a bit by bit basis.

Ports 2 and 3 can be assigned on a bit-for-bit basis as general I/O or interrupt lines. They can also be used as special-purpose I/O lines to support the UART, counter/timers, or handshake channels.

Port 4 is used for general I/O.

During reset, all port pins are configured as inputs (high impedance) except for Port 1 and Port 0 in the ROMless devices. In these, Port 1 is configured as a multiplexed address/data bus, and Port 0 pins $P0_0$-$P0_4$ are configured as address out, while pins $P0_5$-$P0_7$ are configured as inputs.

$\overline{RESET}$. *Reset* (input, active Low). Reset initializes and starts the Super8. When it is activated, it halts all processing; when it is deactivated, the Super8 begins processing at address 0020_H.

ROMless. (input, active High). This input controls the operation mode of a 68-pin Super8. When connected to V_{CC}, the part will function as a ROMless Z8800. When connected to GND, the part will function as a Z8820 ROM part.

R/$\overline{W}$. *Read/Write* (output). R/$\overline{W}$ determines the direction of data transfer for external memory transactions. It is Low when writing to program memory or data memory, and High for everything else.

XTAL1, XTAL2. (Crystal oscillator input.) These pins connect a parallel resonant crystal or an external clock source to the on-board clock oscillator and buffer.

REGISTERS

The Super8 contains a 256-byte internal register space. However, by using the upper 64 bytes of the register space more than once, a total of 325 registers are available.

Registers from 00 to BF are used only once. They can be accessed by any register command. Register addresses C0 to FF contain two separate sets of 64 registers. One set, called control registers, can only be accessed by register direct commands. The other set can only be addressed by register indirect, indexed, stack, and DMA commands.

The uppermost 32 register direct registers (E0 to FF) are further divided into two banks (0 and 1), selected by the Bank Select bit in the Flag register. When a Register Direct command accesses a register between E0 and FF, it looks at the Bank Select bit in the Flag register to select one of the banks.

The register space is shown in Figure 6.

Working Register Window

Control registers R214 and R215 are the register pointers, RP0 and RP1. They each define a moveable, 8-register section of the register space. The registers within these spaces are called working registers.

Working registers can be accessed using short 4-bit addresses. The process, shown in section a of Figure 4, works as follows:

- The high-order bit of the 4-bit address selects one of the two register pointers (0 selects RP0 1 selects RP1).
- The five high-order bits in the register pointer select an 8-register (contiguous) slice of the register space.
- The three low-order bits of the 4-bit address select one of the eight registers in the slice.

The net effect is to concatenate the five bits from the register pointer to the three bits from the address to form an 8-bit address. As long as the address in the register pointer remains unchanged, the three bits from the address will always point to an address within the same eight registers.

The register pointers can be moved by changing the five high bits in control registers R214 for RP0 and R215 for RP1.

The working registers can also be accessed by using full 8-bit addressing. When an 8-bit logical address in the range 192 to 207 (C0 to CF) is specified, the lower nibble is used similarly to the 4-bit addressing described above. This is shown in section b of Figure 7.

Since any direct access to logical addresses 192 to 207 involves the register pointers, the physical registers 192 to 207 can be accessed only when selected by a register pointer. After a reset, RP0 points to R192 and RP1 points to R200.

▷

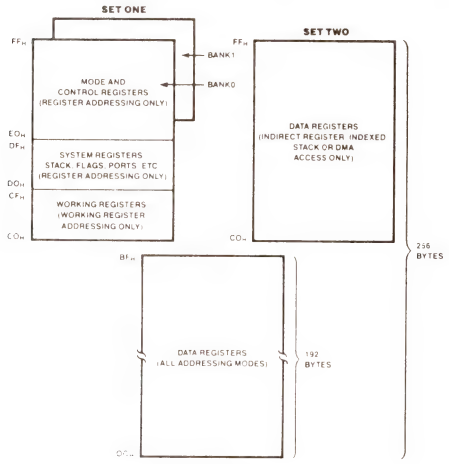
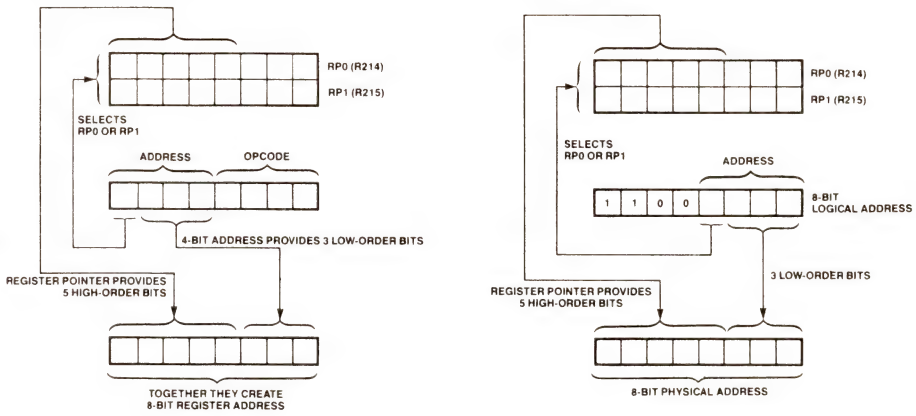

SET ONE
SET TWO
BANK1
BANK0
MODE AND CONTROL REGISTERS (REGISTER ADDRESSING ONLY)
SYSTEM REGISTERS STACK, FLAGS, PORTS, ETC (REGISTER ADDRESSING ONLY)
WORKING REGISTERS (WORKING REGISTER ADDRESSING ONLY)
DATA REGISTERS (INDIRECT REGISTER, INDEXED STACK OR DMA ACCESS ONLY)
DATA REGISTERS (ALL ADDRESSING MODES)
256 BYTES
192 BYTES

Figure 6. Super8 Registers



a. 4-Bit Addressing

b. 8-Bit Addressing

Figure 7. Working Register Window

I/O PORTS

The Super8 has 40 I/O lines arranged into five 8-bit ports. These lines are all TTL-compatible, and can be configured as inputs or outputs. Some can also be configured as address/data lines.

Each port has an input register, an output register, and a register address. Data coming into the port is stored in the input register, and data to be written to a port is stored in the output register. Reading a port's register address returns the value in the input register; writing a port's register address loads the value in the output register. If the port is configured for an output, this value will appear on the external pins.

When the CPU reads the bits configured as outputs, the data on the external pins is returned. Under normal output loading, this has the same effect as reading the output register, unless the bits are configured as open-drain outputs.

The ports can be configured as shown in Table 2.

Table 2. Port Configuration

Port	Configuration Choices
0	Address outputs and/or general I/O
1	Multiplexed address/data(or I/O, only for ROM and Protopack)
2 and 3	Control I/O for UART, handshake channels, and counter/timers; also general I/O and external interrupts
4	General I/O

ADDRESS SPACE

The Super8 can access 64K bytes of program memory and 64K bytes of data memory. These spaces can be either combined or separate. If separate, they are controlled by the $\overline{DM}$ line (Port $P3_5$), which selects data memory when Low and program memory when High.

INSTRUCTION SET

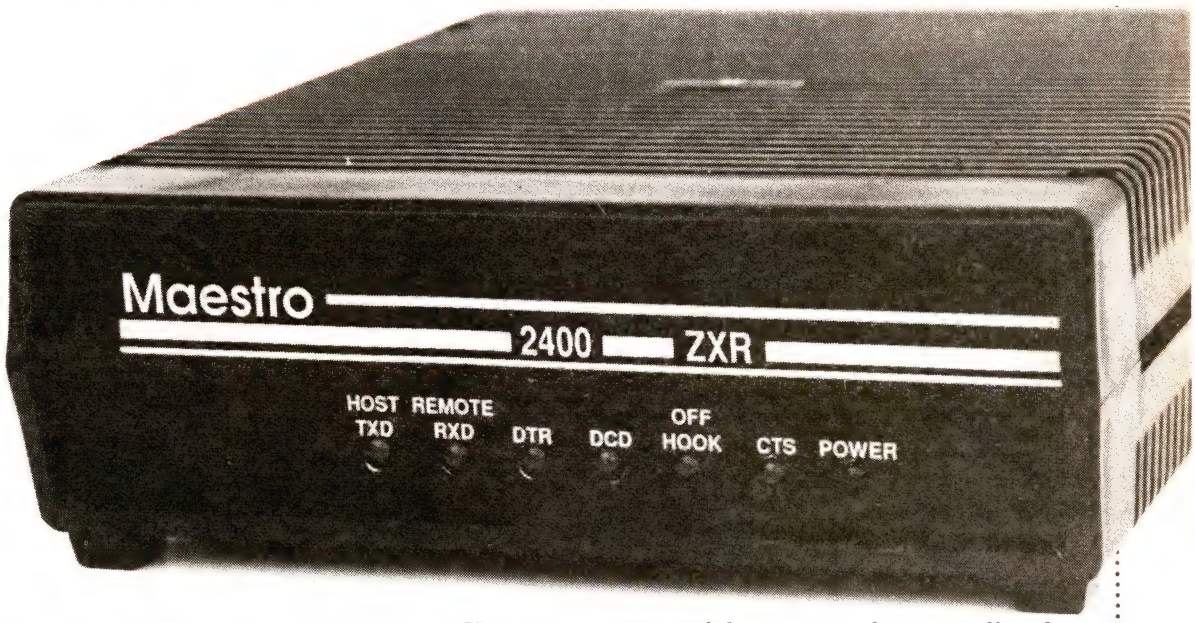
The Super8 instruction set is designed to handle its large register set. The instruction set provides a full complement of 8-bit arithmetic and logical operations, including multiply and divide. It supports BCD operations using a decimal adjustment of binary values, and it supports incrementing and decrementing 16-bit quantities for addresses and counters.

It provides extensive bit manipulation, and rotate and shift operations, and it requires no special I/O instructions—the I/O ports are mapped into the register file.

Address Decimal	Hexadecimal		Mnemonic	Function
General-Purpose Registers				
000-192	00-BF		—	General purpose (all address modes)
192-207	C0-CF		—	Working register (direct only)
192-255	C0-FF		—	General purpose (indirect only)
Mode and Control Registers				
208	D0		P0	Port 0 I/O bits
209	D1		P1	Port 1 (I/O only)
210	D2		P2	Port 2
211	D3		P3	Port 3
212	D4		P4	Port 4
213	D5		FLAGS	System Flags Register
214	D6		RP0	Register Pointer 0
215	D7		RP1	Register Pointer 1
216	D8		SPH	Stack Pointer High Byte
217	D9		SPL	Stack Pointer Low Byte
218	DA		IPH	Instruction Pointer High Byte
219	DB		IPL	Instruction Pointer Low Byte
220	DC		IRQ	Interrupt Request
221	DD		IMR	Interrupt Mask Register
222	DE		SYM	System Mode
224	E0	Bank 0	C0CT	CTR 0 Control
		Bank 1	COM	CTR 0 Mode
225	E1	Bank 0	C1CT	CTR 1 Control
		Bank 1	C1M	CTR 1 Mode
226	E2	Bank 0	C0CH	CTR 0 Capture Register, bits 8-15
		Bank 1	CTCH	CTR 0 Timer Constant, bits 8-15
227	E3	Bank 0	C0CL	CTR 0 Capture Register, bits 0-7
		Bank 1	CTCL	CTR 0 Time Constant, bits 0-7
228	E4	Bank 0	C1CH	CTR 1 Capture Register, bits 8-15
		Bank 1	C1TCH	CTR 1 Time Constant, bits 8-15
229	E5	Bank 0	C1CL	CTR 1 Capture Register, bits 0-7
		Bank 1	C1TCL	CTR 1 Time Constant, bits 0-7
235	EB	Bank 0	UTC	UART Transmit Control
236	EC	Bank 0	URC	UART Receive Control
237	ED	Bank 0	UIE	UART Interrupt Enable
239	EF	Bank 0	UIO	UART Data
240	F0	Bank 0	P0M	Port 0 Mode
		Bank 1	DCH	DMA Count, bits 8-15
241	F1	Bank 0	PM	Port Mode Register
		Bank 1	DCL	DMA Count, bits 0-7
244	F4	Bank 0	H0C	Handshake Channel 0 Control
245	F5	Bank 0	H1C	Handshake Channel 1 Control
246	F6	Bank 0	P4D	Port 4 Direction
247	F7	Bank 0	P4OD	Port 4 Open Drain
248	F8	Bank 0	P2AM	Port 2/3 A Mode
		Bank 1	UBGH	UART Baud Rate Generator, bits 8-15
249	F9	Bank 0	P2BM	Port 2/3 B Mode
		Bank 1	UBGL	UART Baud Rate Generator, bits 0-7
250	FA	Bank 0	P2CM	Port 2/3 C Mode
		Bank 1	UMA	UART Mode A
251	FB	Bank 0	P2DM	Port 2/3 D Mode
		Bank 1	UMB	UART Mode B
252	FC	Bank 0	P2AIP	Port 2/3 A Interrupt Pending
253	FD	Bank 0	P2BIP	Port 2/3 B Interrupt Pending
254	FE	Bank 0	EMT	External Memory Timing
		Bank 1	WUMCH	Wakeup Match Register
255	FF	Bank 0	IPR	Interrupt Priority Register
		Bank 1	WUMSK	Wakeup Mask Register

ZIP into the 21st Century!

with the AEM4624 SUPERbis Modem.



Australian Electronics Monthly, in conjunction with Maestro Distributors are offering the new AEM SUPERbis modem in two configurations:

SUPERbis Modem Kit:

$349 gets you the pc board, all components, case and plug pack. ($316 excl. sales tax).

PLUS $10 DELIVERY

Fully built SUPERbis modem:

$399 grabs you a fully built and tested, Telecom-approved modem! ($336.60 excl. tax).

PLUS $10 DELIVERY

The SUPERbis modem gives you the ability to communicate using all the commonly used speeds available today for around one-third the price of comparable modems. In fact, in most cases, the SUPERbis modem offers superior operation and performance to similar modems due to the advanced technology used in the design.

An advanced modem chip set from Exar is used to achieve the higher speeds, resulting in much improved performance owing to the latest digital signal processing (DSP) technology employed in the Exar chip set.

Here are just some of the amazing features offered to you:

- 300, 1200/75, 1200 and 2400 bps operation
- Fully software controlled using a Super8 microprocessor with firmware written in Forth
- Hayes AT 2400 compatible
- Auto-answer, auto-dial operation
- Full call progress and telephone line monitoring with automatic retraining
- 32K of ROM on-board
- 8-32K of RAM available, also on-board
- Extensive self-testing

As this modem is fully microprocessor controlled, using the Forth programming language you are assured against obsolescence.

Don't miss out, order now!

There are two easy and convenient ways to order your new SUPERbis modem; either

PLEDGE your PLASTIC over the phone:

ring (02)555 1677 and give Ingrid your credit card details

OR

send the coupon to:
AEM SUPERbis MODEM OFFER
1st Floor, 347 Darling Street,
BALMAIN 2041.

Name: .....

Address: .....

.....

..... **P/Code** .....

Phone: .....

I am paying by: ☐ Cheque ☐ Money Order ☐ Bankcard ☐ Visa ☐ MasterCard

Cheque/Money Order No.: .....

(please make cheques or money order payable to "Australian Electronics Monthly")

Credit Card No: .....

Signature: .....

(unsigned credit card orders cannot be accepted)

KENWOOD

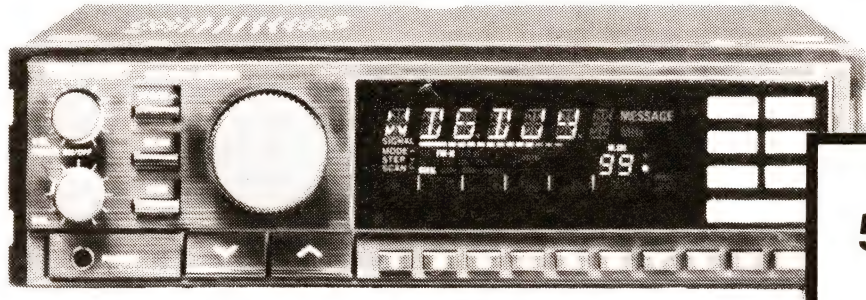
TS-680 HF TRANSCEIVER

100 WATTS OUTPUT ON 160 to 10 METRES
10 WATTS OUTPUT ON 6 METRES

The TS-680 is a high-performance HF transceiver designed for SSB, CW, AM and FM modes of operation on all Amateur bands. Covers Amateur bands 160 metres to 6 metres, combining the ultimate in compact size with advanced technology.

Compact and lightweight. CW Full Break-In, Semi Break-In and VOX Circuit. Superior receiver dynamic range. The receive front end has been specifically designed to provide superior dynamic range. The intermodulation dynamic range is 102dB, with an overall intercept point of + 12dBm, noise floor level of — 138 dBm. (when the optional 500 Hz CW filter YK-455C-1 installed). 31 Memory channels with split memory channels and memory scroll. Built-in dual-mode noise blanker ("Pulse" or "Woodpecker".) IF shift circuit. Adjustable VFO tuning torque. Switchable AGC circuit (FAST/SLOW) and built in speech processor, RF output power control and "F.LOCK" switch. Non-volatile operating system. Fluorescent tube digital display and squelch cicruit (for FM mode).

STOCK • STOCK • STOCK
BULK SHIPMENTS JUST ARRIVED



NEW RZ-1 WIDEBAND RECEIVER
"THE SCANNERS DELIGHT"

COVERS 500 KHz TO 905 MHz RANGE

The new KENWOOD Wideband Receiver is a multipurpose receiver that covers the 500KHz-905MHz range. Its advanced features are made possible through the use of advanced microprocessor technology.

Features Wideband Frequency Coverage (500KHz — 905MHz), including FM Stereo Broadcast and Multi-Channel Television Sound. 100 Easy-To-Operate Multi-Function Memory Channels with Message Capability. 10-Band Programmable Capability. Keyboard Frequency Selection. Auto-Mode and Auto-Step Operations. Multi-Scan Function. Easy-To-Read Large LCD Display. Compact and Lightweight. Auto-Selectable Dual Antenna Terminals. Built-in speaker. Front-mounting phones jack. Easy-to-operate, illuminated keys. Accessory terminals are Line Out/Video Out/External Speaker Terminal. Squelch circuit for FM (narrow) mode. UP/DOWN Keys for VFO and memory channel.

KENWOOD ELECTRONICS AUSTRALIA PTY. LTD.
4E WOODCOCK PLACE, LANE COVE, SYDNEY, N.S.W. 2066. Ph. (02) 428 1455.

YOUR DEALER BELOW WILL GUARANTEE SATISFACTION

Further, beware of dealers not listed in this advertisement who are selling Kenwood communications equipment. All Kenwood products offered by them are not supplied by Kenwood Electronics Australia Pty. Ltd. and have no guarantee applicable.

N.S.W.:
EMTRONICS — 94 WENTWORTH AVENUE, SYDNEY (02) 211 0988
REG STOCKMAN COMMUNICATIONS — CNR BANOCKBURN ROAD & SHIRLEY STREET, INVERELL (067) 22 1303
WORMALD COMMUNICATIONS — 51 DENNISON STREET, HAMILTON, NEWCASTLE (049) 69 1999
ROBERTSON ELECTRONICS — 62 DESMOND STREET, CESSNOCK (049) 90 7908
MACELEC PTY. LTD. — 99 KENNY STREET, WOLLONGONG (042) 29 1455
ALEX JOHNSON — 19 BANKSIA STREET, O'CONNOR, A.C.T. (062) 47 9125
DX ENGINEERING — 158 GRANITE STREET, PORT MACQUARIE (065) 84 9922
FRANK BOUNDY — USMORE (066) 86 2145

INTERSTATE

VIC.:
PARAMETERS PTY. LTD. — 1064 CENTRE ROAD, SOUTH OAKLEIGH (03) 575 0222
EMTRONICS — SHOP 5 TO 7, 288-294 QUEEN STREET, MELBOURNE (03) 670 0330
BRIAN STARES — 11 MALMSBURY STREET, BALLARAT (053) 39 2808
SUMNER ELECTRONICS — 78 KING STREET, BENDIGO (054) 43 1977

TAS.:
WATSONS WIRELESS — 72 BRISBANE STREET, HOBART (002) 34 4303
MARINE & COMMUNICATION — 19 CHARLES STREET, LAUNCESTON (003) 31 2711
V.K. ELECTRONICS — 214 MOUNT STREET, BURNIE (004) 31 7733

QLD.:
MITCHELL RADIO CO. — 59 ALBION ROAD, ALBION (07) 357 6830
EMTRONICS — 416 LOGAN ROAD, STONES CORNER, BRISBANE (07) 394 2555

S.A. & N.T.:
INTERNATIONAL COMMUNICATIONS SYSTEMS PTY. LTD. — 8 NILE STREET, PORT ADELAIDE (08) 47 3688

W.A.:
WILLIS ELECTRONICS — 165 ALBANY HIGHWAY, VICTORIA PARK (09) 470 1118
BAY RADIO — 22 GRACE STREET, FERNDALE (09) 451 3561
FORD ELECTRONICS — UNIT 19, 70 ROBERTS STREET, OSBORNE PARK (09) 242 1766

CRT display for new Icom HF rig

Amateur band transceivers have developed remarkably in recent years, but Icom has added a whole new dimension to the concept of "bells and whistles" with the release of the new IC-781 HF transceiver.

Featuring a cathode ray tube display reminiscent of latest generation airliner cockpits, the IC-781 can display up to 200 kHz of the spectrum adjacent to the selected frequency allowing visual location of other signals in the band chosen.

Both VFO frequencies are displayed, and can be monitored simultaneously through the "dual watch" facility. The CRT display also provides visual, menu-driven tracking of memory data storage, and multiple filter configurations.

The IC-781 shares all of the "standard" features of earlier Icom transceivers, namely – independent passband tuning circuits, high shape factor filters, direct digital synthesis (DDS) frequency locking, RS-232 computer interface, speech processor and so on.

A heavy duty power supply, together with a 100% duty cycle final amplifier, are provided to guarantee trouble-free operation on RTTY, AMTOR or packet.

Retailing at around $10 500, the IC-781 is plainly not for everyone, but we all need something to aspire to, do we not?
For further information, contact

Icom Australia, 7 Duke St, Windsor 3181 Vic. (008)338 915.

"Goldfest '88"

Gympie in North Queensland grew on gold last century, then turned to other industries for a livelihood after the initial "rush" died out. Now, with the aid of BHP, gold is once again booming in Gympie.

The Gympie Amateur Radio Club is joining in the town's "Goldfest 88" goldruch festival with a "hamfest" that promises to offer something different from the big cuty style events.

Venue will be the Chatsworth Hall/Chatsworth School on the northern outskirts of the city. The date – Saturday 8th October '88. The fun commences at 0900.

Further details from **Alan Gardner VK4BWG, Gympie Amateur Radio Club, PO Box 384, Gympie 4570 Qld.**

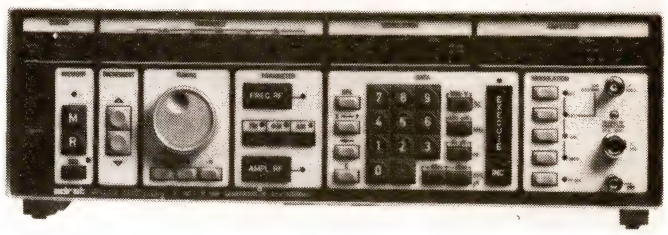
High purity signal generator

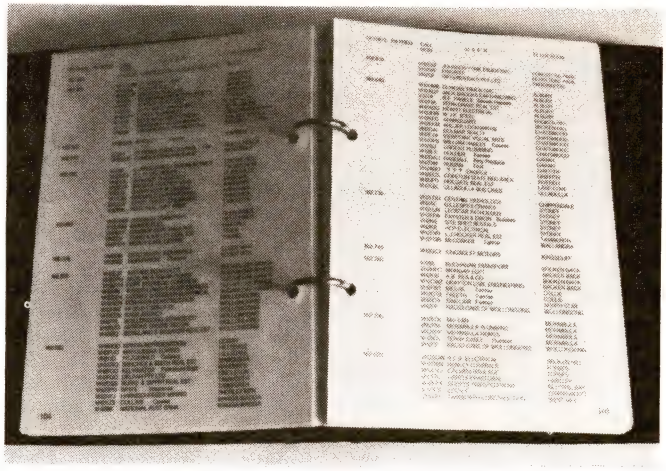
Vicom Australia P/L has released the new model 742A signal generator from Adret which claims high spectral purity over a frequency range of 100 kHz to 2.4 GHz.

The 742A has some interesting features including dc and ac coupled modulation input with switchable ALC, programmable internal AF generation from 20 Hz to 12.8 kHz and a very low RF leakage of better than 0.5 uV, according to the specs.

Vicom are marketing the 742A in direct competition with the renowned range of HP gear, and claim superior performance in many areas.

For further information contact your local Vicom Sales Office, or phone **(03)690 9399.**





New Icom UHF handheld

Icom handhelds have long enjoyed a reputation for quality units in the smallest of packages, and the latest IC-4GAT UHF transceiver seems to confirm the feeling.

The new handheld boasts up to 6 w output power, 20 memory channels and standby operation for reduction of power consumption to around 25% of normal.

Frequency selection is by digital touchstep switches – the modern equivalent of thumbwheel switches. A backlit LCD display indicates the selected frequency.

Recommended retail price for the IC-4GAT is $654. For further information, contact **Icom Australia, 7 Duke St, Windsor 3181 Vic. (008)338 915.**

Updated frequency lists

Captain Communications has released an updated set of Frequency Registers for Australian HF/VHF/UHF stations, compiled for scanner enthusiasts.

The HF Register covers 2.009 – 26.965 MHz Australia-wide and the VHF/UHF Registers cover 42.5 – 512.925 MHz on a state-by-state basis.

Each register lists the transmit and receive frequencies (for duplex users), call sign, licensed user and transmitter location.

The HF register is priced at $38, each VHF/UHF Register is $24.50, and a Master Register of VHF/UHF for all states is $100. Captain Communications is at **28 Parkes St, Parramatta 2150 NSW. (02)633 4333.**

Spectrum hound's delight – Kenwood's RZ-1 scanner

Scanning receivers have steadily improved in features, functions, performance and coverage over the past few years. Kenwood's new RZ-1 would probably represent the "culmination" of recent developments.

KENWOOD'S announcement last December that they would launch a "wide band receiver" was greeted here at AEM with some interest. Being a late entrant into the scanner market, Kenwood seem to have benefitted from the experience of those who came before them.

The RZ-1 crams a host of desirable features into a package that measures just 180 x 50 x 176 mm. Many readers will no doubt recognise that this fits into a "standard" dash hole for car radios. While the receiver is clearly meant for vehicle use (and not just because of its size), it is readily adaptable to bench or "base" use as four small snap-in plastic feet are provided.

The RZ-1 is dc-operated, requiring a nominal 13.8 V supply, although the specifications give a range of 11 to 16 volts. Thus, for mains operation, a 12.5 or 13.8 V dc power supply is required.

Features and functions

The RZ-1's most obvious, and most attractive, feature is the frequency coverage – from 500 kHz to 905 MHz! Thus, the one receiver can be used to cover the major sound broadcast bands, the shortwave broadcast bands and the myriad of VHF and UHF "service" bands.

Four channel steps are provided – 5 kHz, 12.5 kHz, 20 kHz and 25 kHz. Manual tuning can be done with either "up/down" keys or a rotary knob, which provides continuous rotation – clockwise for increasing frequency, anti-clockwise for decreasing frequency. Any frequency within the range may be entered by means of ten numeric pushbuttons on the front panel. These pushbuttons are used to enter a "start" frequency for tuning, as well as limit frequencies for scanning.

Three reception "modes" are provided: AM, narrowband FM and wideband FM. The latter provides reception of broadcast FM transmissions from stations located in the 88-108 MHz broadcast band and television station sound channels. The narrowband FM mode is for reception of voice transmissions from VHF and UHF fixed, mobile and aeronautical stations. The AM mode provides for reception of AM broadcast band (500 kHz to 1.6 MHz), shortwave band (to 30 MHz), and aeronautical band (120 MHz) transmissions.

FM stereo reception is available, with output via two RCA sockets on the rear panel. From the handbook, USA versions of the RZ-1 provide a TV reception option (NTSC), with output to a monitor on the rear panel. Unfortunately, a PAL TV decoder is not available.

The RZ-1 features a multi-function liquid crystal display. It can show the selected frequency (always in MHz), a "message" of up to seven characters (part of the memory function), signal strength, reception mode, channel step, scan mode, memory channel, programmable band operation, and one of six "symbols". The latter are meant to be a mnemonic during memory operation. The symbols are a radio, a TV set, a car, an aeroplane, a yacht and a smiling face with what appears to be a microphone!

Completing this incredible list of display functions is the "stereo" indicator that lights with FM stereo reception when the signal strength is sufficient to detect the stereo subcarrier.

One hundred memory channels are provided, each capable of being programmed to set up the receiver for a prescribed frequency, function, mode, message and a symbol. The "message", of up to seven characters, is shown on the receiver's front panel liquid crystal display in lieu of the frequency. The message can be made up from some 48 characters, including the alphabet, 0-9 and a variety of special characters.

Two antenna inputs are provided, one for connecting a normal car radio antenna, the other for connecting a wideband antenna. Automatic antenna selection can be switched in so that the appropriate antenna is selected according to the frequency band in use. An attenuator may be switched in and out on antenna 1 to reduce the effects of strong signal overload.

A whole variety of scanning and frequency selection options are incorporated. You can scan between set frequency limits, scan memory channels, automatically step up and down in frequency or by memory channel. In "VFO mode", the tuning knob on the front panel permits manual tuning, as described earlier.

External appearance

The RZ-1 presents a stylish appearance, with an all-black brushed alloy fascia and white lettered controls. A slightly jarring note, however, is provided by the seven white rectangular function buttons on the far right-hand side. These seem a little out of place on an otherwise refined looking unit.

The pushbuttons themselves, whilst operating perfectly satisfactorily, have a rather disconcerting "wobbly" feeling, rather reminiscent of cheap calculators. They are by necessity spaced closely, but operation is nevertheless not difficult, even for the average ham-fisted user. Mobile selection of channels or modes would be something to get used to, though. Selection with the rotary knob would be the far preferable option when mobile.

When power is applied the front panel is dominated by the backlit LCD, with subtle but more than adequate illumination behind the function buttons. Backlighting for the LCD is the plain yellow-white of tungsten globes, except behind the "stereo" indicator and the last few signal strength points, where it is red.

A fair bit of heat is generated in the region of the front panel, but whether this is due to the lamps or the nearby microprocessor control unit is hard to say.

The rear apron provides two RCA connectors for stereo FM reception output, an external speaker jack, a cable for the dc input connection and two coax cables with in-line

The RZ-1 is a compact receiver that is really three receivers in one – an AM/FM tuner, a shortwave receiver and a VHF/UHF scanner!

SPECIFICATIONS

Frequency Range		U.S.A. version : 500 kHz ~ 824 MHz Other market version : 500 kHz ~ 905 MHz
Mode		A3E (AM) F3E (FM-N, FM-W) C3F (T.V visual, NTSC) (U.S.A. version)
Antenna Impedance		50 ~ 300 Ω (50 Ω nominal), Unbalanced (ANT 1 and ANT 2)
Power Requirement		11 ~ 16 VDC (13.8 VDC nominal)
Ground		Negative
Current Drain: AUDIO OUTPUT (1 W)		1 A
Operating Temperature		−10°C ~ +60°C (14°F ~ 140°F)
Dimensions (W × H × D)		180 × 50 × 176 mm (7.0″ × 2″ × 6.9″)
Weight		1.5 kg (3.3 lbs)
Frequency Step	Manual Mode	5 kHz, 12.5 kHz, 20 kHz, 25 kHz
Sensitivity	AM (10 dB S/N)	5 μV
	Medium-wave broadcasts	Less than 10 μV
	FM-N (12 dB SINAD)	Less than 6 μV (less than 60 MHz) Less than 3 μV (more than 60 MHz)
	FM-W (12 dB SINAD)	Less than 1 μV (83 MHz)
Squelch Sensitivity (FM-N mode)		Less than 0.1 μV
Memory Channel		100
Output Power	EXT.SP	More than 2 W (across 8 Ω load 5% distortion, FM 1 kHz, ±3 kHz DEV)
	LINE OUT	150 mV
	T.V visual (U.S.A version)	1 Vp-p, 75 Ω
FM-W STEREO Separation		More than 30 dB (1 kHz)

antenna sockets (ant. 1 and ant. 2).

Internally

The view with the top cover removed is a sight to behold, and a tribute to modern technology. The first pleasant surprise is that there is plenty of length to the speaker wire so that, with the cover off, it can be placed flat on the bench nearby, rather than being balanced precariously, restricted by short wires.

The initial feeling of flimsiness suggested by the action of the pushbutton switches is thoroughly dispelled following a viewing of the internal construction of the RZ-1.

The main chassis is a solid die-casting with a separate integral section for the RF unit. Considerable use is made of surface-mounted components, and separate sections are built on individual printed circuit sub-assemblies, some as small as 20 x 30 mm. With top and bottom covers removed at least seven of these different boards are visible.

Considering the functions provided by the unit, and the complexity of the circuit, there is a remarkable amount of room to move inside the chassis. Test points and sockets are clearly marked, and this plus the modular nature of the unit suggests that servicing should not present any particular difficulties.

On the air

The RZ-1 is delightfully simple not just to use, but to learn to use! The operation and function of all major controls is pretty well self-evident and it takes but a few minutes familiarity to get sensible results. An hour or so with the well thought out, clearly laid out and copiously illustrated instruction manual and you'll have the memory, scan and special functions licked. And Kenwood thoughtfully include a circuit with the instruction manual.

The receiver was given a thorough workout right across the frequency range where we knew of signals of interest. On a one metre length of hookup wire, the VK2RSY beacons at Dural, some 28 km from our office at Balmain, were readable on the 52, 144 and 432 MHz bands, indicating the sensitivity of the RZ-1 is well up to scratch. With an external antenna, the RZ-1 really pulled in some signals. We even tried "copying" a few satellites. As expected, the polar orbiting weather satellites on 136 MHz really "roared" in.

On the shortwave bands, AXM from Canberra was readily received on the "one metre" hookup wire antenna. Plenty of Pacific and further afield stations could be received at good strength from only a modest antenna.

There are two drawbacks with reception below 30 MHz. First is lack of single sideband reception, and second is the 5 kHz minimum channel step. The bandwidth on AM reception is clearly a compromise between adequate reception on the AM broadcast band and reasonable selectivity for shortwave reception.

In mobile use, you'd have to set up the RZ-1 while you were stationary and only use a minimum of controls while on the move, else leave operation to a passenger. This is because of the necessarily small buttons and controls owing to the unit's compact construction.

The RZ-1 handles strong signals quite well. Signs of overload and crossmodulation were not evident until extreme circumstances were encountered, the RZ-1 happily coping in circumstances where earlier model scanners had long "given up". The two antenna facility was at once a joy and a blessing, but we lean more to the side of joy as it's a practical feature. Few practical antennas (be they for fixed or mobile use) are able to cover such an enormous frequency range and the two antenna inputs are a recognition of this.

In summary

The Kenwood RZ-1 would have to be classed as a top-line scanner, in features offered, functions and performance. Considered as an "AM/FM broadcast tuner" with added bonus of shortwave reception and typical scanning receiver facilities, the RZ-1 is little short of brilliant!

The unit is as ergonomically functional as you could get, given the size constraints. It is a breeze to operate and to program, and it performs well up to current expectations. At a purchase price of a little under $1100 dollars, it represents good value for money because you virtually get three receivers in one!

Roger Harrison VK2ZTB,
and Jeff Ralph VK2KCQ

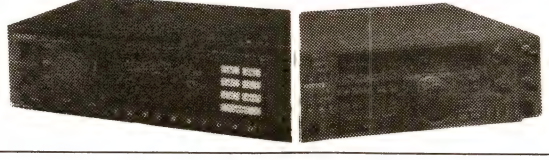
Review unit kindly provided by Kenwood Electronics Australia, PO Box 348, Lane Cove 2066 NSW. (02)428 1455.

SCANNERS PARADISE

- Best range
- Best service
- Technical advice

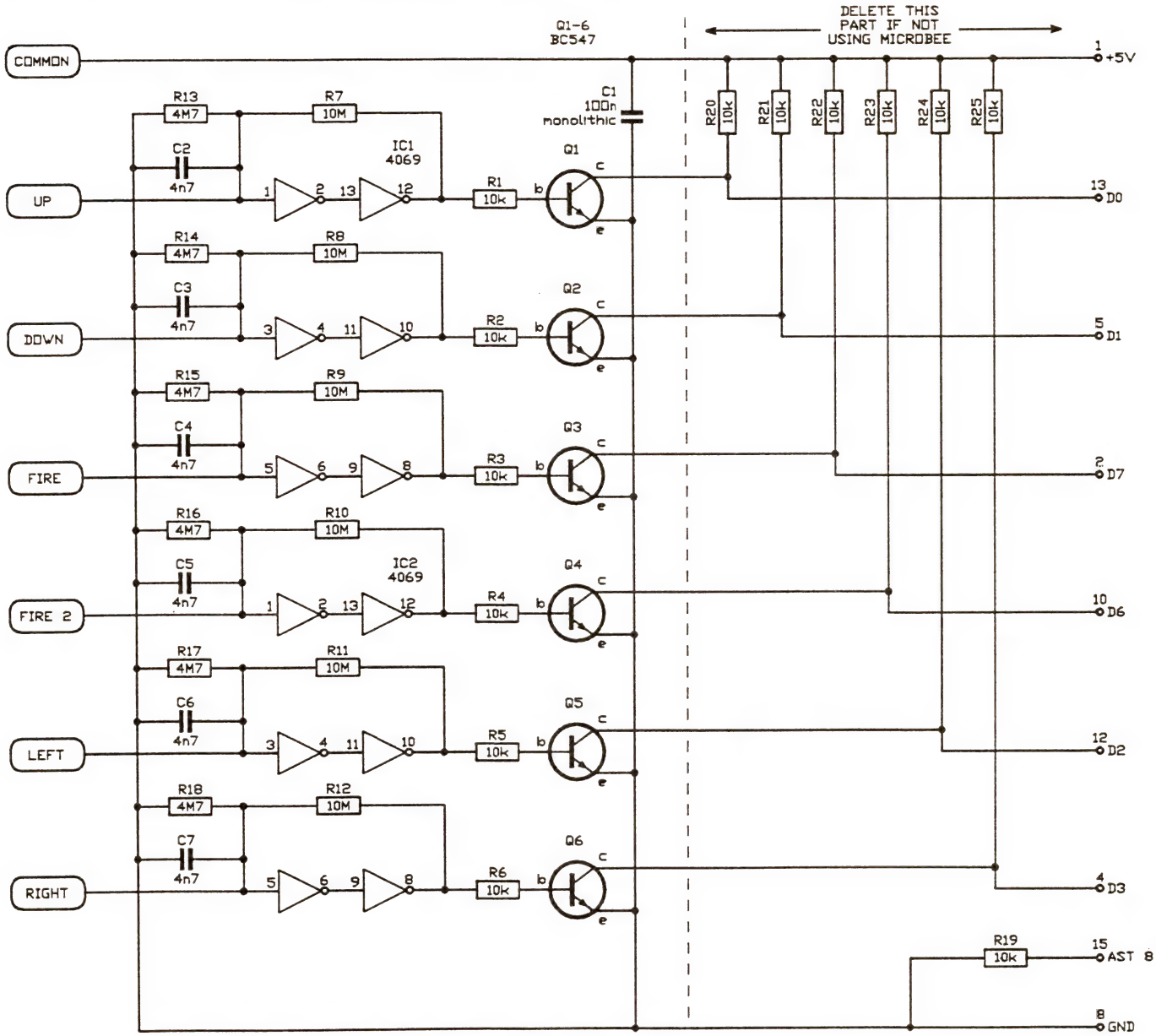
- Kenwood
- ICOM
- Bearcat
- Cobra
- Sangean
- Challenger

KENWOOD RZ-1 KENWOOD R5000



CAPTAIN PTY LTD COMMUNICATIONS

28 Parkes Street, Parramatta 2150
or phone **(02) 633 4333** for same day delivery.
Fax: 891 2271 for further information. We accept
Bankcard, VISA, Mastercard. Mail orders our speciality.



Electronic touch joystick for the Microbee

Here is the circuit for a "touch" joystick that plugs into the parallel port of a Microbee computer. I designed it after many people complained about the unreliability of the mechanical joystick that I was originally using.

As everyone knows, a standard joystick consists of four microswitches activated by the movement of a vertical pole. After a lot of use, these switches tend to become unreliable, giving false inputs to the computer and generally destroying the ease of program control that they are supposed to provide. Also, because the pole is the main moving part, it, or some of its associated mechanical fixings inside the joystick case may break, usually ruining the device for life.

The advantages of this touch joystick is simply that it has NO moving parts, and that means that once it is built, the only maintenance needed is an occasional wipe of the touch contacts.

It works in this way: In my circuit, I have used electronics switches instead of mechanical microswitches. They work by virtue of the fact that when you touch the contacts representing the response you want, a very minute amount of electrons flow from these contacts through your body to another contact which is connected to +5 volts. (Don't worry, the level of current flowing is in the order of microamps or less).

The "direction" and "fire" button contacts are each connected to a very sensitive voltage detector consisting of two inverters in series, a 4M7 resistor and a 4n7 capacitor connected in parallel to ground, and a 10M resistor acting as a sort of "feedback" path between the input and the output of the invertor chain. Whenever the contact is "bridged" to ground, the small current triggers the circuit and turns on the BC547 transistor. This has the same effect as turning on the microswitches in the mechanical type of joystick.

I have included an additional detector wired up as a second fire button and connected to bit 6 of the 'Bee's parallel

port. This may be left out is desired, but make sure that the input to the inverters is tied to either +5 Volts or ground via a 4k7 resistor.

As the circuit is, it is set up for plugging directly into the parallel port of a Microbee, but it can be connected to other computers if the right hand part of the circuit (right of the transistor emitter connections) is left out and the collectors of the transistors are wired to the appropriate pins of a 9-pin D-type connector.

I built up my project on a piece of Veroboard small enough to fit inside a small 80 x 50 x 30 all plastic jiffy box. For the contacts I glued pieces of copper to the lid where I wanted them to be (having soldered a piece of wire to the underside of each first), and fed the wires through small holes drilled in the lid under where the contacts were to be placed.

For the common contact I used two pieces of blank circuit board, one glued to either side of the jiffy box. All the wires can be run out of a 9 mm hole drilled in one end of the box. The copper contacts won't need cleaning very often as only a very small current is needed to trigger the switch, so don't be too worried if your contacts get very dirty.

Finally, you will need a program to test your new joystick. Here is a small program I wrote to test the program on my Microbee. It is written in MicroWorld BASIC and makes use of colour if you have a colour monitor (it uses Premium BASIC colours, so they may need to be changed if the program is used on a standard machine).

When running, the program reads the parallel port and prints on the screen exactly which contacts have been touched. Note that if you are using the second fire button, change 143 to 207 in the program on line 160, or else "Fire2" will be printed regardless of what the joystick is doing.

Happy gaming!!!

Craig Dewick,
Cronulla, NSW

Epson printer clone checker

Want to know which model Epson printer you have or which type your Epson clone emulates? Well, here's a test for all MX-series printers.

From BASIC, type:

LPRINT "J";CHR$(27);"JJ";CHR$(8);"K"

The HEX equivalent of this is:

4A 1B 4A 4A 08 4B 0D 0A

if you wish to send this by a means other than BASIC.

And the results:

An MX80 Type I will print "JJK".

An MX80 Type II or MX100 will print JK

A Graftrax 80 will 'hang' and beep.

An MX80 Type III and Graftrax Plus will print "J", feed forward three or four lines and print "K" directly under the J.

–from "The Sting",
WA Microbee Users Group Newsletter,
March 1988

KENWOOD

NEW
WIDEBAND RECEIVER

COVERS 500 KHz TO 905 MHz RANGE

ONLY $1045

The new KENWOOD Wideband Receiver is a multipurpose receiver that covers the 500KHz-905MHz range. Its advanced features are made possible through the use of advanced microprocessor technology.

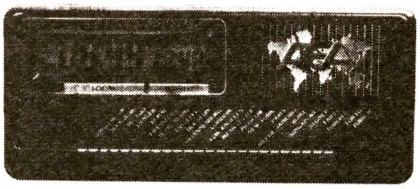
Features: Wideband Frequency Coverage (500KHz — 905MHz), including FM Stereo Broadcast and Multi-Channel Television Sound. 100 Easy-To-Operate Multi-Function Memory Channels with Message Capability. 10-Band Programmable Capability. Keyboard Frequency Selection. Auto-Mode and Auto-Step Operations. Multi-Scan Function. Easy-To-Read Large LCD Display. Compact and Lightweight. Auto-Selectable Dual Antenna Terminals. Built-in speaker. Front-mounting phones jack. Easy-to-operate, illuminated keys. Accessory terminals are Line Out/Video Out/External Speaker Terminal. Squelch circuit for FM (narrow) mode. UP/DOWN Keys for VFO and memory channel.

Specifications Frequency Range: 500KHz — 905MHz Mode: A3[A3E] (AM), F3[F3E] (FM) Circuitry: AM, FM(N) = Triple conversion system FM(W) = Double conversion system Sensitivity: AM (S+N/N = 10dB) = Less than 5 uV (BC band 10uV). FM (N) = 12dB SINAD less than 6uV (500KHz — 60MHz) less than 3uV (60 — 905MHz). Operating Temperature: -10° - +60°C. Audio Output Power: 2W (at 8 ohms load 10% distortion). Current Drain: Less than 1A (audio power output 1W). Antenna Impedance: 50 - 300 ohms. Power Requirement: 13.8VDC ± 15%. Dimensions: 180(W) x 50(H) x 158(D) mm. Weight: 1.5kg.

New AEA World Clock

Amateur radio can take you around the world, and the new AEA World Clock lets you know the proper time when you get there. With dual digital displays you see local time and any of 24 selected time zones side by side. The slide bar on the bottom of the clock can be moved to the city/zone you want, and the display automatically changes to the proper time for that time zone.

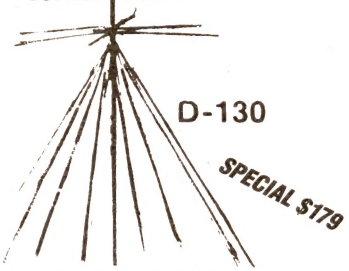
ONLY $39



24 Hour Display—Both displays show 24 hour time. • **Lighted Display**—Light button for night viewing. **Daylight Savings Switch**—Shows Standard/Daylight Savings conversion. • **Batteries Included**—Two AAA batteries installed **Date Line Indication**—Display shows + / - for international day change • **Compact Size**—2" x 4.5" x 5" **Alarm with delay**—Six minute snooze feature included with alarm.

The AEA World Clock is perfect for use in the station and travel. A folding easel stand positions the clock for desktop use, and a leather-like travel pouch is also included.

SUPER FOR RZI



D-130

SPECIAL $179

AVAILABLE AT ALL STORES

NEW BROADBAND OMNIDIRECTIONAL ANTENNA 25 TO 1300 MHZ

The new D-130 is one of the latest generation full coverage HF/VHF/UHF omnidirectional antennas. It provides continuous operation from 25 to 1300 MHz and is ideally suited to the likes of the AR-2002, the Icom ICR-7000 or RZ-1 scanning receivers. Also capable of transmitting on 6m, 2m, 70cm, 33cm and 23cm bands.

EMTRONICS

CORRESPONDENCE:
Box K21,
HAYMARKET, NSW 2000

NSW & HEAD OFFICE:
92-94 WENTWORTH AVE, SYDNEY
NSW 2000. TLX: AA73990
PH: (02) 211 0988 P.O. BOX K21
HAYMARKET NSW 2000

VICTORIA
288-294 QUEEN ST. MELBOURNE
VIC 3000 (Entrance from
Lt. Lonsdale St)
PH: (03) 678 551 or 670 0330

QUEENSLAND
416 LOGAN ROAD,
STONES CORNER
QLD 4120
PHONE (07) 394 2555
FAX 07 3944316

MAIL ORDERS WELCOME

The Last Laugh

WITH THE ONGOING PROBLEM of cross-infection that is so prevalent in the world (as was so ably demonstrated in the history of European contact with the outside world), we not only shared our technology with the less advanced but also our diseases. The common cold has decimated cultures such as the Alaskan Eskimos and the Australian Aborigines in times past.

We now find **ourselves** in the same predicament as the computer invades our offices and factories. People are being struck down in increasing numbers with esoteric diseases of which only two have been categorically defined, and controversy still rages over whether *these* maladies are valid, or just figments of the victim's imagination.

These two debilitators of our workforce are RSI and computer viruses.

RSI is the result of spending too many hours in direct physical contact with an operating quasi-intelligent machine, and results in the nerves of the arms trying to mutate into a form which can directly access the information streams of the device being operated.

Its a sad case of evolution gone wrong, as the electrical fields generated by the machine induce the desire for the operating body to coalesce into a symbiotic relationship with its superior.

It *has* been strongly argued that this could not be so, as there has never been any record of this phenomenon detected among the technical staff who have a far more intimate association with these types of machines. Actually, this really strengthens the case, as this is a problem which manifests itself in a downward path from more intelligent to less intelligent lifeforms. Computers get bugs from programmers, and secretaries, typists and clerks get RSI from computers and associated equipment.

Computer viruses work in a less direct path than RSI, as will be demonstrated. History has it that computer viruses were manufactured by malevolent programmers who desired to cause mayhem in the computing world for their own reasons, be they revenge, mischief or subversion.

In the classic style of Frankenstein's monster, computer viruses have struck indiscriminately at all they came into contact with. In a similar manner to nurses who contract leprosy after years of dressing the wounds of victims of that malady, so, in a far shorter time, this putrescent binary bug has decimated the technocratic scene in a singular and insidious display of fiendish fundamental ferocity. Both computers and people alike are succumbing to this sinistral scion of suffering.

I'll have one of these carphones with Her Majesty's number in Memory 1 and Bob's in Memory 100.
Yes, Excellency.
Wouldn't want to get them confused, would we?!
No, Excellency!

This month's picture is a recent PR shot from Philips, showing Philips executive John Dearn talking to the Governor General about a Philips carphone. We couldn't resist musing on the conversation.

The classic symptoms of the virus in humans only appear after a terminal condition has been attained. They are as follows: wide, malevolently staring eyes; dishevelled hair; monosyllabic speech punctuated by emphatic euphemisms and expletives couched in computerescent cultural communicants; lack of energy; sleep deprivation caused by a fanatical desire to continue to operate computers; an inordinate hatred for academia in all its forms and appearances; complete mental dysfunction in all social graces; and lastly, a superior and intolerant attitude to any lifeform considered to be of lesser social or technical status then that of the afflicted party.

This binary biological bug has no known remedy, and to make things worse our medical fraternity not only don't know how to start to tackle this potently pernicious problem that is affecting our beloved bucolic buffoons. Rather than even start, however, they categorically insist that the problem sits squarely in the domain of the psychologists and psychiatrists. The psionic practitioners of infirm intellects and other indicative inanities unequivocally refuse to accept the challenge and are maintaining a status quo of *Null Interferum Infinitum*.

That, sadly, is the situation to date, and the only issue untouched so far is the question of quarantine. These blighted members of society are freely mingling with all and sundry, and nobody knows the potency of their possible effect on the structure of a society which is already reeling under the effects of academia on our infants and adolescents being churned through the school system.

Will mankind survive these impediments to our progress and overcome them as it has overcome similar obstacles in the past, and pass on to the future halcyon days awaiting it on the other side of its vision of *per ardua ad astra*? Tune in next issue and you may not be disappointed, but don't count on it.

E.Kusilek Ph.D. (failed)

THE WORLD WIDE HOBBY!
AMATEUR RADIO
ARE YOU A MEMBER OF THE WIA?

Why not become a radio amateur by joining the Wireless Institute of Australia? The Institute can assist and advise you in how to obtain a Department of Communications licence, which will allow you to communicate with others having similar interests in Australia and throughout the world.

The Wireless Institute of Australia is a non-profit society founded in 1910. Since its inception it has nurtured the interests of all Australian amateurs by liaison at all Governmental levels.

Apart from many other benefits as a member, you receive a monthly plastic encapsulated 64 page magazine called Amateur Radio in your letter box each month.

This magazine contains information on all aspects of the hobby such as Technical Projects, Hints and Kinks, Computer Programs, Free Classified Advertisements and Technical Reviews. Regular columnists give details of Contesting, Awards, DX News, Ionospheric Predictions and Solar Activity, Overseas News and VHF/UHF Activity, to name but a few.

SUPPORT YOUR HOBBY — become a member!

For further information, including a sample magazine, write to:
WIRELESS INSTITUTE OF AUSTRALIA
PO BOX 300
CAULFIELD SOUTH, VIC. 3162

Registered Address: 3/105 Hawthorn Road, Caulfield North, Vic.

BKP AD87012

SIEMENS

Surge Arresters

Gas arresters and metal oxide varistors

There's an explosion of new demands for surge voltage protection.

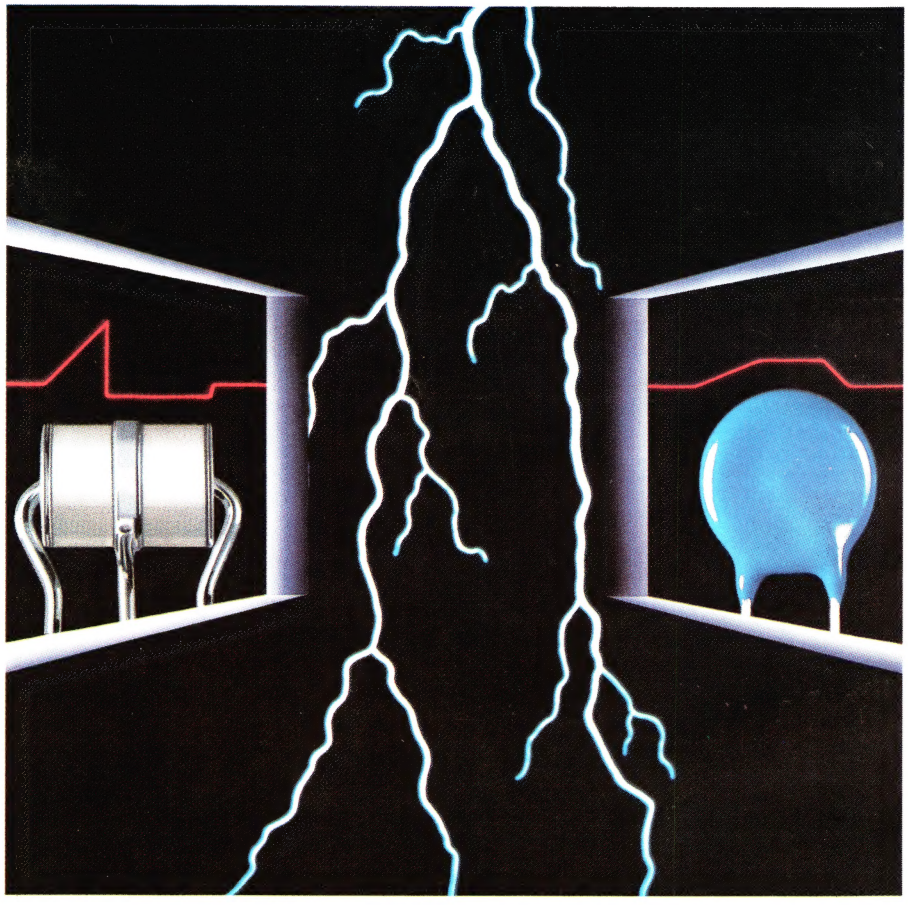
To keep up, you need instant access to a total protection system. So you need Siemens Gas arresters and metal oxide varistors. Our huge range is available immediately from large local stocks, at competitive prices.

And all components reflect the very essence of Siemens High Technology – premium quality, performance and reliability.

Of particular note is Siemens innovative range of metal oxide varistors – unlimited applications, including the total protection of automotive electronics. Also, space-saving SMD varistors are available, along with our unique heavy duty block types – that's protection up to 100 kA!

We can even customize components to meet your individual requirements.

For more information, contact your nearest Siemens office or distributor.



Siemens Ltd.
Sales Offices
Melbourne: 544 Church Street, Richmond, Vic. 3121
Phone: 420 7318
Sydney: 383 Pacific Highway, Artarmon, N.S.W. 2064
Phone: 436 8711
Brisbane: 9 Parkview Street, Milton, Qld. 4064
Phone: 369 9666
Perth: 153 Burswood Road, Victoria Park, W.A. 6100
Phone: 362 0123
New Zealand: Level 9, Marshall House,
142-146 Wakefield Street, Wellington, N.Z.
Phone: (4) 846 068

Siemens. A higher technology

CSA 3295 SL